REPORT OF THE TECHNICAL COMMITTEE

ON

LARGE-SIZED KUTCHA IRRIGATION WELLS

MINISTRY OF FOOD AND AGRICULTURE
DEPARTMENT OF AGRICULTURE
NEW DELHI

LIST OF CONTENTS

Page No.

1. Introductory - background details and terms of reference 1 - 4
2. Technical details of construction ... ... 4 - 6
3. Cost of construction ... ... 6 - 7
4. Technical details of operation ... ... 7 - 9
5. Cost of operation and recoveries from beneficiaries ... 9 - 11
6. Structural stability and maintenance of the well ... 12
7. Water output of the well... 12
8. Irrigation capability of the well ... ... 12 - 20
9. Comparative economics of the wells in relation to other feasible schemes for Sultanpur area.. ... 20 - 25
10. Claims, views, and opinions about different aspects of the scheme: ... 25 - 29
    - (a) Construction cost.
    - (b) Discharge of the well.
    - (c) Structural stability.
    - (d) Availability of land, free of cost.
    - (e) Scope and utility.
    - (f) High charges for irrigation water supplies.
    - (g) Chain reaction.
    - (h) Indirect advantages of the scheme.
11. Over-all scope and utility of the scheme ... ... 29 - 32

APPENDICES

(i) Appendix I - Original scheme submitted to the Prime Minister in May, 1956.

(ii) Appendix II - Supplementary note, on the scheme, dated 2nd June, 1956.

(iii) Appendix III - Subsequent note, on the scheme, dated 30th April, 1960.

(iv) Appendix IV - Comments of the Planning Commission.

(v) Appendix V - Comments received from State Governments.

(vi) Appendix VI - Report of Technical Committee, which examined the results of test observations made in West Bengal.

(vii) Appendix VII - Note of Dr. T.R. Mehta on the agricultural aspects of the scheme.

(viii) Appendix VIII - Note of Dr A.K. Dutt on the agricultural aspects of the scheme.

REPORT OF THE TECHNICAL COMMITTEE ON LARGE-SIZED KUTCHA IRRIGATION WELLS.

A Technical Committee comprising the following Members was set up in the Ministry of Food & Agriculture (Department of Agriculture), New Delhi, to examine the scheme of Large-sized Kutcha Irrigation wells, suggested by Shri M.A.T. Iyengar and to assess economic feasibility and utility of this Scheme;

(1)	Shri Mahavir Prasad, Irrigation Advisor.	(Chairman)
(2)	Shri M.A.T.Iyengar, 96, Constitution House.	(Member)
(3)	Shri J.P. Mittal, Advisor (Irrigation) Ministry of C.D. & Co-op.	-do-
(4)	Shri B.S. Johri, Director, C.W. & P.C.	-do-
(5)	Dr. T.R. Mehta Director Farm Advisory Unit	-do-
(6)	Shri G.D. Aggarwal, Production Economist	-do-
(7)	Shri Dilbagh Singh Dhesi, Irrigation Specialist	-do-
(8)	Dr. A.K. Dutt, Soil & Fertilizer Specialist.	-do-
(9)	Shri Jagat Kishore Jain, Deputy Irrigation Advisor	Member-Secretary

Shri M.A.T. Iyengar initially submitted the scheme to the Prime Minister in May, 1956, in the form of a note which is enclose *vide* Appendix I. Some aspects of the scheme as indicated in this note, were later revised vide a supplementary note dated 2nd June, 1956, enclosed vide Appendix II. Shri Iyengar's latest ideas on the scheme are indicated in his note dated the 15th April, 1960, (enclosed vide Appendix III), submitted to the Minister for Food & Agriculture.

The scheme made the following claims:

(a) The proposed well under the scheme would cost Rs. 25,000/-, irrigate 420 acres and produce annually crops worth Rs. 42,000/-.

(b) The scheme, besides being economical t

p. 2 ..

benefit considerations, would bring about numerous other benefits in the form of providing; increased potential for employment; opportunities for constructive co-operation on an intensive scale; power consumer potential for electricity in rural areas; drinking water with scope of kitchen gardening; and scope for rehabilitation purposes through utilisation of waste and unproductive lands.

(c) The scheme would set up a chain reaction by yielding an annual return of Rs. 42,000/- (in the form of food production against the initial investment of Rs. 25,000/-), which money can be utilised again for further investment on an increasing scale.

The scheme was examined in the Planning Commission as well as in the States. The comments of the Planning Commission are enclosed vide Appendix IV. None of the States felt inclined to take up this scheme on the grounds; that the scheme was not suited to their local conditions; and that the scheme of tubewells, filter points and lift irrigation from streams and rivers, already in vogue, were more feasible. The replies received from 13 States are enclosed vide Appendix V (Serial i-xiii). Workability of this scheme was considered doubtful by them in following respects;

(a) The yield of the well is not likely to be of the order indicated.

(b) The cost of construction will be appreciably higher than estimated cost and not commensurate with the benefit derived.

(c) The well will occupy a large amount of costly land, which may not always be available free of cost.

(d) The well may not remain structurally stable.

Shri Iyengar had attempted construction of such wells at some 98 places, as a relief measure in District Bankura, West Bengal where he had been District Magistrate. The Government of India desired the State Government of West Bengal to complete five of these wells, which might be in, comparatively, advanced stage of excavation and to carry out detailed experiments. The finances for the purpose were offered as grants from Government of India. The West Bengal Government, however, did not agree even to take up these trials as they did not envisage any scope for the scheme in their State.

At the instance of Shri Iyengar, test observations on two of these wells, suggested by him, were carried out. These tests

p. 3....

indicated recouperation in the well to be less than 400 gallons per hour for draw-down heads of the order of 10' to 20'. The report of these tests was examined by a Technical Committee of the Government of India, who came to the conclusion that discharge and benefit derived from such wells might not be commensurate with the cost of these wells. The report of this Committee is enclosed vide Appendix VI.

The Ministry decided to have further experimental trial of this Scheme and a proto-type well of the design specified by Shri Iyengar was constructed in village Sultanpur in the Union Territory of Delhi. The excavation work was started in December, 1958, and completed around July, 1960.

The Ministry ~~have~~ appointed this Committee to assess the performance and economics of the experimental well and also make an over-all assessement of the utility and scope of the scheme. The actual terms of reference to the Committee are as under:-

(i) To examine technical and financial details covering construction, operation and maintenance of the completed experimental Large-sized Kutcha Irrigation Well at Sultanpur; carry out test observations that are considered necessary; verify any data considered doubtful; and assess, on scientific basis;

- (a) The water output of the well.
- (b) The irrigation capability of the well.
- (c) The comparative economics of the well in relation to other feasible schemes for the area.

(ii) To examine the various proposals and claims made about the cost and performance of the scheme and the views expressed by the State Governments and by the Government of India on the utility and the feasibility of the scheme; and make an over-all assessment, based on scientific reasoning and relevant technical data available, of the utility and scope for the scheme in relation to other ground-water utilisation schemes.

The Committee held eight meetings and examined the various claims, views and opinions about the scheme and discussed various technical features and financial details. Two Members of the Committee, Dr. T.R. Mehta and Dr. A.K. Dutt submitted a note each to the Committee, dealing with some aspects of the scheme from the agricultural point of view. These notes are enclosed vide Appendics VII and VIII

p. 4 ......

respectively. The Members of the Committee also inspected the experimental well at Sultanpur on a number of occasions and carried out such test observations, that were possible within the time at the disposal of the Committee.

The Committee was all along helped by the staff of Delhi Administration in the examination and investigations carried out and the test observations performed. The Assistant Irrigation Advisorand the Technical Assistant (Minor Irrigation) in the Ministry of Food & Agriculture also greatly assisted the Committee by performing the arduous task of maintaining hour to hour record of the performance of the well for a fortnight during the first half of December, 1960.

Technical details of construction:

The experimental well at Sultanpur is a large conical pit excavated in the ground. Its top diameter at ground level is 200 feet and bottom diameter about 30 feet. The bottom of the well is about 60 ft. below the ground-level. The excavated earth is deposited on the ground in the form of a ring-bund around the well. The well occupies a total area of nearly 1½ acres, at the ground-level. The inside slopes of the excavated well gradually become steeper as the depth increases, the initial slopes being 2 : 1. Horizontal berms have been provided at intervals along the slopes.

The lowest portion of the well to a depth of about 20 ft. goes down almost vertically. It has partially been lined with boulder pitching in about half the circumference and to a height of about 7 ft. Work was probably stopped half way due to arrival of monsoon rains.

About 10 open bores are reported to have been attempted at the bottom of the well, out of which about 5 are said to be functioning more satisfactorily than others. The depth of the bores is understood to be ranging between 100 ft. to 150 ft.

The construction of the well was initially entrusted to the Central Public Works Department. However, the minimum tender received for earth work by the C.P.W.D. was for an amount 77.6% higher than the provision (of Rs.23,000/-) made in the estimate for this item. The tenders were, therefore, rejected

p. 5 ...

and the work was subsequently arranged to be carried out through the agency of the Chairman of Village Development Council. Payments for earth work etc. were made through running bills prepared on the basis of actual measurements and estimated rates.

The excavation work has been done by manual labour, mostly imported. The Committee gathered that the beneficiaries did not participate in the excavation of the well.

The static water table in the well was about 15 ft. below the ground level during the excavation work in June, 1959. Dewatering during excavation was carried out by a diesel engine pump-set, which had been purchased against the estimate and is now being used for operation of the well. This pump-set comprises 10 to 12 B.H.P. vertical type Cooper make diesel engine, and 5" x 4" centrifugal pump coupled with the engine by means of a V-belt. Five masonry platforms had been built up at different elevations, for working and moving about the pump-sets during the excavation period.

The original estimate of the experimental well provided for the construction of a pump-house for the protection and operation of the pump-set. No such structure, however, has actually been constructed at site. The Committee gathers that perhaps the idea to construct the pump-house has now been dropped altogether.

The construction of the well has taken nearly two years. The total quantity of earth work involved is of the order of 5 lakh cubic feet, of which, about 2 lakh cubic feet is under water excavation. Taking on an average, a labour rate of Rs. 2/- per day, the construction of this well should require about 25,000 man days. This would mean continuous working of 50 men for 500 days. As the well would be located in cultivated areas, labour for construction work would be available mainly in the slack seasons of agricultural activity. The Committee feels that the construction of a well of this type will not normally take less than 3 agriculture seasons, that is, a period of $1\frac{1}{2}$ years.

Water courses constructed on the well have been carried on high embankment with a view to including a large area in the command of the well. In the Committee's opinion, these high level channels

p. 6.....

built in heavy filling will not be easy to maintain.

Cost of construction:

The original estimate provided Rs. 40,000/- as the cost of the well. This was made up of different items as under:-

(i)	Earth work excavation	Rs. 23,000
(ii)	Installation of pumping set including pump-house.	Rs. 8,700
(iii)	Acquisition of land	Rs. 7,500
	Total...	Rs. 39,200

As against the above estimate, the Committee analysed in detail the expenditure actually incurred on the construction of the well. The total up-to-date expenditure on completed items is as follows:

(1)	Excavation of well	Rs. 40,410
(2)	Stone pitching inside the well for protecting the bank from land slide	Rs. 853
(3)	Grassing or turfing	Rs. 118
(4)	Boring holes	Rs. 826
(5)	Installation of engine and pump-set	Rs. 5,481
	Total	Rs. 47,688

The land in the case of this experimental well belonged to the village Community (not to individual cultivators) and was obtained free of cost as a special case. In addition to the expenditure detailed above, a requirement of Rs. 3,500/- has been indicated for meeting part-cost of water courses constructed on the well. This would make the total cost of the well as Rs. 51,188/-. There is, however, also a pending claim of about Rs. 13,000/- in respect of the dewatering charges. If this is accepted, the cost of the well will go up to Rs. 64,000/-.

It was brought to the notice of the Committee that occasionally some delays had occured in payments of bills, and it was suggested that the cost of the well would have been actually lower if timely payments had been made. The Committee, however, is not in a position to say whether these delays would have made any appreciable difference in the total cost and if so to what extent.

p. 7 .....

The Committee feels that the cost of digging the wells to the depths as envisaged under the scheme would be higher in areas which have: (a) good water bearing strata, so that a heavier order of dewatering and under-water excavation is involved; (b) low depths of water table, so that amount of excavation increases; and (c) rocky sub-stratum below the top soil, so that the expensive item of rock blasting is involved. The Committee also feels that the cost of land should also be included in assessing the total cost of the well because land to the extent of about 1½ acres may not normally be available free of cost.

Technical details of operation:

As soon as pumping is commenced on a well, the water table at and in immediate vicinity of the well starts receding. The yield of the well increases with the increase of depression in the static water level at the well and water table continues to deplete till the total amount of withdrawal of water from the well, within certain period, is balanced by the total amount of yield in the well during that period. With a view to utilising maximum potential of the well, Shri Iyengar envisages working of the well upto large draw-down heads of the order of 30 ft. to 35 ft. (i.e., with depressions 30 ft to 35 ft below static water level).

The operation of the well at such large draw-down heads is likely to present many difficulties in handling of the diesel engine pump-set. The suction limit of the pump is normally limited to about 15 ft. to 20 ft. only, that is the pump can depress the water level to a depth of 15 ft. to 20 ft. only below the surface at which it is installed. For initial operation of the well, the pump-set may be installed a few feet above the static water level. As stated earlier, the static water level at Sultanpur well may be taken as approximately 15 ft. below the ground level, on the basis of observations made during construction period of the well. The first stage platform for operation of the pump set on this well has been built at an elevation of about 12 ft. below the ground level.

As the water level recedes gradually, and a depression of about 15 ft to 20 ft. is created, the pump set must be shifted to a second stage platform, for further continued operation. The second

p. 8 ....

staging has been constructed at an elevation of about 22 ft. below the ground level at Sultanpur well. From this staging, the maximum depression, that may be created may be of the order of about 24 ft. below the static water level.

Operation of the well at a higher depression than this will necessitate shifting down both the engine and the pump to a third stage platform, which may be built at an elevation of about 36' or so below the ground level. If a yield of about 4,000 to 4,500 gallons per hour is assumed (as is approximately indicated by the December observations discussed later). when the water level in the well is a few feet below the third staging, it is calculated that the water level would rise by about 6 feet in 24 hours, in case pumping is stopped due to some mechanical defect or say sudden rainfall. It is evident that under any such emergency, both the engine and the pump will have to be shifted up at very short notice and within very limited time at disposal in order to save them from drowning. This repeated up and down shifting along the steep slopes of the sides of the well, which may often be wet, will require everytime a sizeable strength of labour and also utmost care in handling to prevent untoward happenings.

On open wells, worked with diesel engine pump sets, normal practice is to construct a pump-house adjunct to the masonry steining of the well. This pump-house is fitted with suitable arrangement of belt drive and counter shafts to enable operation of the pump at different stagings without having to shift the diesel engine below the static water level. All the Members unanimously felt that such an arrangement was desirable in the case of kutcha irrigation well to facilitate its operation, which otherwise is very difficult and cumbersome. However, the construction cost of such a pump-house, in view of the deep depth and conical shape of the well, is likely to be so high that it may make the scheme inordinately uneconomical

The Committee examined possibilities of using some alternative means for operating the well with ease and at large draw-down heads, but could not think of any satisfactory arrangement. The vertical or the submersible pumps are usually

p.9 ....

the technically sound equipment for pumping under conditions of receding or fluctuating water level. These pumps, however, are very expensive in initial cost. Besides, installation of the vertical pump would again involve construction of a very expensive structure that may be out of question. Submersible pumps, on the other hand, would require electrical drive as the prime-mover. Bringing electricity to the well would be a costly item

The Committee also considered the possibility of installing the pump set on a floating raft, which would go up and down automatically with the water level in the well and, thus, avoid shifting of the pump-set up and down along the steep and wet slopes. This, too, however, was not considered satisfactory arrangement as this would create strong vibrations and also result in the coupling shaft of the pump-set getting out of alignment quite frequently. The pump-set will, thus, require frequent repairs and re-adjustments, thereby increasing the cost of operation and rendering sustained running of the pump-set, during the period of keen irrigation demand, almost impossible.

Thus it seems that there may not be any alternative resource, but to operate the well by repeatedly shifting the pump-set up and down. This, however, as explained earlier, is not a satisfactory arrangement and involves risk to both men and equipment, particularly when the pump-set is operated at the third staging for fully utilising the potential of the well. In view of these facts, the Committee feels that the design of the well in question may not be convenient for a general use of power pumping at draw-down heads of high order, although the Committee recognises the need of encouraging the use of mechanical power for water lifting.

Cost of operation, water lifting and recovery from beneficiaries.

As mentioned earlier, 10 to 12 horse power diesel engine has been installed for powering the pump and lifting water. The observations, under actual working conditions, made during the first fortnight of ~~the~~ December, 1960, show that during this period, the pump had worked for an average of 8 hours per day. Reckoning that irrigation requirement will normally be felt for about 250 days in a

p. 10 ....

year and that pump will be operated for 8 hours per day on the average, the total number of hours run by the pump during a year should be about 2,000. On this basis, it is estimated that the annual cost of operation and maintenance of the pump-set (excluding interest charges) will be about Rs. 8,575/-. This will be broadly made up as follows:-

Diesel oil @ half gallon per hour: 1000 gallons @ Rs. 2.75 per gallon	Rs. 2,750/-
Engine oil and lubricants at one gallon per 16 hours working: 125 gallons @ Rs. 9/- per gallon	Rs. 1,125/-
Depreciation, repair, over-hauling, sundries and miscellaneous:	Rs. 2,000/-
Operating staff: One operator Rs. 150/- per month) One Helper-cum-Chokidar Rs. 75/- pm)	Rs. 2,700/-
Total...	Rs. 8,575/-

(Enquiries during working of the pump-set in 1st fortnight of December, 1960, shows that consumption of engine oil is of the order of one gallon per 12 hours working. This is considered to be on the high side and a figure of one gallon, including engine oil as well as other lubricants per 16 hours working, has been assumed in the above calculations).

If the average discharge of the pump is taken as 13,000 gallons per hour (on the basis of actual observations made in the first fortnight of December, 1960) and interest charges are calculated at 4½ % on the capital investment assumed as Rs. 60,000/-, the average cost of water lifting works out to Rupee one per 2,300 gallons, which is equivalent to Rs. 9.75 nP per acre inch.

Up to March, 1960, Delhi Administration paid all the bills for oils, lubricants, consumable stores and salaries of the staff, etc. in connection with the operation of the pump-set. However, since April, 1960, no such bills have been paid by them. It is gathered that the beneficiaries have set up a sort of managing agency for the operation of the well. Shri Ramji Lal, Chairman, Village Development Council who and whose family own between them a major portion of the commanded area, is the Chief Executive of this agency.

On the basis of the total annual expenditure on operation as outlined above and the irrigation capability of the well as assumed later (page [illegible]) the irrigation rate merely to defray the operational

p. 11 ....

charges of the well is likely to be of the order of Rs. 100 per acre which is manifold higher than those usually levied on the flow or even lift irrigation schemes. In ordinary course of the scheme, the beneficiaries will also be required in addition, to pay, in regular instalments, substantial amounts towards initial cost of the well. The experience on other irrigation schemes shows that the beneficiaries are not willing to pay even irrigation charges that are many times lower than a rate of about Rs. 100/- or so for crop acre, likely to work out for this Scheme.

It was pointed out by one of the Members that the cultivators in Sultanpur area were already paying about 1/3rd or 1/4th of the share of total produce on land to the other farmer, who supplied him with water for irrigation. Delhi Administration, who were asked to furnish full details on this point, have reported that when a cultivator borrows water from an irrigation source belonging to another cultivator, he pays at a rate of about Rs. 2.00 to Rs. 2.50 per bigha (1/5th of an acre) per crop season to the owner in lieu of using his source and as far as the operation of the irrigation source is concerned, he uses his own draught animals. Although, if his labour and that of his animals is evaluated in terms of money, the total cost of water lifting in such an arrangement may even exceed Rs. 100/- per crop acre, but he has the satisfaction of paying a nominal amount of only Rs10/- to Rs. 12/- per acre in cash, and of making up the rest by using his own labour and his own animals. It appears doubtful if the cultivators would be willing to make cash payments of the order of Rs. 100/- or so in preference to using their own labour and their own bullocks for operating the water source.

The Committee, therefore, apprehends doubts if the scheme will be able to run on self-financing basis unless active and intensive extension measures are adopted in the form of a drive and cultivators are fully educated in the use and advantages of improved agricultural and irrigation practices and in the desirability of releasing their bullock power from lift irrigation activity for a more exclusive use on these practices.

p. 12 ...

Structural stability and maintenance of the well:

As mentioned earlier, the well is intended to be operated at large draw-down heads, at least during the major part of its annual working period. The Committee apprehends a possibility that sustained pressure from a draw-down of this order may, in course of time, draw in soil particles and adversely affect the stability of the well. In fact, a depression of this order has always been avoided in all construction of open wells in the country so that the sub-strata are not disturbed and the failure of wells is prevented. The Committee is of the opinion that unless the behaviour of the well in question is actually watched for a few seasons under the working conditions contemplated in the scheme, it may not be possible to vouch for the stability of the well.

As attempt has indeed been made already, though not envisaged in the original design, to protect the sides of the bottom portion of by boulder pitching. The Committee feels that even this boulder pitching also may have a tendency to gradually slip down and thus, require constant attention. This may turn out to be expensive and difficult item of regular maintenance.

Earth work on the banks and the sides and also the turfing will require regular maintenance to prolong the life of the well. In spite of regular maintenance, there is risk that boring at the bottom of the well may, in course of time, get choked with silt and mud, either drawn with sub-soil water because of high depression or collected at the bottom due to gradual erosion (there may be some erosion even in spite of turfing) of the steep kutcha sides of the well.

Water output of the well:

In the scientific sense, the water output of a well means the sustained average discharge that may be obtained from the well, for days together without depletion of water level in the well to unworkable limits, during the period of keenest irrigation demand in different crop seasons. The water output would primarily depend on the yield of the well during that period, and also on the storage capacity of the well. When pumping is started after a spell of closure, the water output will be mostly obtained from the storage; later as pumping

p. 13....

continues deliveries from the well will be contributed more and more by the yield of the well.

The yield of a well varies from season to season; it appreciably increases during the rainy season depending upon the amount of rainfall and topography. The water output of the well may, thus, vary from season to season.

The yield of a well also increases with draw-down head, at a rate, which is usually lesser than that of direct proportion; and depends somewhat on the design of the well. In case of tubewells, when the draw-down increases from 20% to 80% of the maximum obtainable depression, i.e., when the draw-down increases four times, the increase in yield is about 2.75 times. It cannot be said with certainty, whether the same or nearly the same relationship will also hold good for kutcha wells of the type under consideration.

During a spell of sustained working of the well for meeting keen irrigation demand, the benefit of storage in the well is not likely to last beyond a few days. The maximum water output or potential of the well will, thus, be limited by the yield that may be obtained by working the well with the maximum draw-down possible.

A reliable estimate of this water potential of the well which will vary from season to season, cannot be made merely by theoretical projections of the results based on one or two observations of limited nature. In the first instance, the maximum workable draw-down will be limited by various uncertain factors, like: (a) the minimum water level in the well, which should not be depressed further in order to maintain adequate sub-mergence over the foot-value of the pump and to avoid lifting, of slush and mud, which may choke the foot-valve and the impeller of the pump; (b) the depth or the staging up to which the engine and the pump can be conveniently lowered without undue risk along the steep and wet slopes of the well; and (c) Safety or stability of the well itself. It is difficult to make an assessment of these factors unless the actual working of the well is observed during a few seasons.

Secondly, as the diesel engine pump-set cannot normally work for more than 12 hours or so daily, its discharge should be nearly

p. 14 ...

double that of the well, so that 24 hours yield of the well can be pumped out in 12 hours. It would mean that the water level in the well must all the time fluctuate. As soon as the pump is stopped, the water level in the well would rise. The storage, thus, built up would again be depleted the next day when pumping is resumed. Thus, the effective draw-down contributing to yield in the well will be less than the maximum draw-down attained during pumping.

Lastly, if rate of recouperation of well is observed, corresponding to a particular water level and during a particular season, the result of such observation cannot be theoretically projected to give a reliable forecast of yield corresponding to other elevations of water level in the same season. Moreover, as both the yield and the static water level vary from season to season, the result of such observation cannot also be applied to give a reliable yield corresponding to the same water level in other seasons.

In view of the above considerations, the Committee feels that it is essential to make comprehensive observations, during actual working of the well for a few consecutive seasons in order to fully determine on scientific lines the water output of the well in different seasons.

The Committee attempted to make whatever observations were possible within the short period at its disposal and under the working conditions obtaining on the well during this period. One of the handicaps from which the Committee suffered was that the well remained more or less completely closed for irrigation during the month of August and even later, it was used for irrigation sparingly. It was only since the last week of November that a comparatively sustained spell of working for irrigation had obtained on the well.

The Committee arranged to make one observation during the last week of August for the water output of the well during the monsoon season. For the purpose of this observation, the Committee wanted to depress the water level to about the actual working range, but could do no better than to depress the water level only by a few feet. Depressing of the water level further would have required shifting down of the pump-set and also created other difficulties. The shifting of the pump was risky in this season when there was seepage from the sides of the well and these were

p. 15.......

wet and slippery. The Chairman of the Village Development Council was not willing to take the risk of ~~the~~ shifting down the pump. Moreover, there was no place for disposal of the pumped out water as there was no demand for irrigation and all fields were saturated. The Committee's observations had, thus, limited scope and there were some further difficulties about its interpreation as the position of static water level at the time of observation could not be precisely determined. Allowing the water in the well to recouperate till it reached a steady level, could not be possible as the well had to be run soon after for irrigation of cauliflower. The static water level was reported to be at an elevation 85 (reckoning the ground-surface as 100), during the excavation of well in June, 1959. As the static water level fluctuates from season to season and from year to year, it would not be correct to assume for it the same elevation during present observations, unless some more confirmatory data was available.

Observations were consequently made on the surrounding wells and these indicated that the static water level varied from elevation 86 to 87 on the side of the Sultanpur village and between 82 to 83 towards the lake side. The inference that could be drawn from these observations was that the static water level on the well in question would be somewhere between elevation 82 and 87. If on the basis of this inference and the observations made in June, 1959, it is assumed that the static water level during the present observations was at an elevation 85, the Committee's observations places the yield of the well in the monsoon season at 2,400 gallons per hour with a drawn-down head of about 10 ft.

The Committee considered in addition to its own observations, the results of 3 sets of observations carried out by Delhi Administration during the construction of the well. The results of these observations together with those of the Committee are as under:-

Date of observation	Yield in gallons per hour	Water level of the well during observations (reckoning ground-level at datum elevation 100)
Delhi Administration's observations		
11th & 12th Jan. 1960 (i.e. cold weather)	1900	Water level rose from elevation 52.5 to 68.

6th April, 1960 (i.e. early summer)	6000	Round about elevation 50.
2nd July, 1960 (i.e. hot weather)	1400	Round about elevation 68.5.
Committee's observation:		
29th August, 1960 (i.e. rainy season)	2400	At elevation 75.20.

The time and the seasons and also the levels of the well to which the above observations pertain have been indicated against these observations. As regards the static water level during these observations, however, an assumption has to be made in each case.

With a view to collecting more observational data on water output under working conditions of the well, the Committee attempted to maintain for a fortnight (between 29th November, 1960, and 14th December, 1960) a complete record of (a) number of hour run by the pump from day to day for irrigation; (b) discharge of the pump; and (c) water level fluctuations from day to day in the well as irrigation progresses. An extract of these observations is given below:

(i)	Water level at the commencement of the observation (8.30 a.m. on 29.11.60): (Reckoning ground level at 100)		74.39
(ii)	Water level at close of the observations (8-30 a.m. on 14.12.1960)		... 66.48
(iii)	Total drop in water level in 15 days: ...		... 7.91
(iv)	Total number of hours run by the pump: (a) actually observed by the staff: ... (b) reported by pump-driver:	 90 36	126. hours
(v)	Total volume of water pumped out... ...		16,22,000 gallons or 72 acre inches.
(vi)	Total volume of water contributed by storage on the well:		2,20,000
(vii)	Net volume recouperated in the well: ...		14,02,000
(viii)	Average number of hours run per day by the pump		8-2/5 hours.
(ix)	Average quantity of water pumped out per day ...		1,08,000 gallons or 4.8 per acre inches
(x)	Average discharge of the pump per hour ...		12,000 gallons
(xi)	Average yield of the well per hour (item vii divided by 24 x 15)		3,900 gallons

The above observations reveal that while the pump had been lifting

p. 17 .....

water on an average rate of a little less than 5 acre inches per day, water level in the pump had steadily been receding daily and in 15 days had gone down by 7.91 ft. At the close of the observations, the maximum draw down attained during pumping was of the order of 21 ft. (reckoning static water level at elevation 85) and the water level had still been receding while pumping at an average rate of about 1,08,000 gallons per day (24 hours). It may be inferred from these observations that the total yield in 24 hours of the well, when attaining the maximum draw-down of 21 ft. during pumping, is less than 1,08,000 gallons, which is the total quantity pumped out during the corresponding period of 24 hours. It means that the yield in the well at a draw-down of this order is less than 4,500 gallons per hour. On this basis, the maximum yield that may be obtained at a maximum draw-down of the order of 30 ft. to 35 ft. could perhaps be set at 6,000 gallons per hour. However, to utilise a yield of this order, the engine and the pump will have to be lowered to the 3rd staging and its sustained running will have to be assured for at least 12 hours and even more per day. This had not so far been possible till the end of Committee's observations.

On the basis of observations so far made, the Committee feels that the effective water output of the well, accounting for the yield as well as storage provided by it, may be taken as in the range of 4 to 6 acre inch. per day (24 hours) for the rabi reason. It means that the sustained quantity of water that may be extracted from the well, every 24 hours, during the rabi season, is in the range of 4 to 6 acre-inches, irrespective of whether it is obtained by working the high capacity pump or two pumps for a few hours only, or a low capacity pump for a much longer period. On an average, the water output may be taken as about 5 acre inch per day for this season. For getting more precise value of the water output for the rabi as well as early and late kharif seasons, the Committee is of the view that continued set of observations should be taken for a few consecutive seasons covering the actual working of the well during the entire period in each season.

Irrigation capability of the well:

The area irrigated on this well as also on other wells in the

p. 18 ....

vicinity was discussed with the Revenue Officer and staff of the Delhi Administration. It was indicated that the well irrigated about 28 acres during rabi 1959-60. It is also gathered that the well irrigated about 27 acres during kharif, including Zaid kharif crops like tomatos, chillies, brinjals and early cauliflower etc. It is also revealed that the area brought under irrigation is not entirely new as some area under the command was receiving irrigation water from an adjoining masonry well, whose rabi irrigation has consequently dropped from about 14 acres to 4 acres, during rabi 1959-60.

The irrigation performance of an irrigation source, though primarily a function of the water output, also depends considerably on external factors, such as (a) cropping pattern adopted; (b) land preparation and methods and practices employed for field application of water; (c) systems and practices adopted for distribution of water; (d) use of fertilizers and other improved agricultural practices and techniques; (e) amount and distribution of rainfall; and (f) soil and other climatic conditions. These factors influence the area irrigated in three ways: (i) by making comparatively more or less intensive use of the source around the year; (ii) by affecting the water losses in the distribution system and in the field; and (iii) by affecting consumptive requirements of crops.

To some extent the above factors may be influenced by the nature of the irrigation source in as much as a larger irrigation source commanding a larger area may provide somewhat better scope for effecting improved irrigation and agricultural practices. However, the enterprising nature of the farmers and the assistance and education provided by Extension and other similar organisation or services play a major role in contributing towards the above factors.

As these factors may thus vary widely from place to place and year to year and are not amenable to precise assessment, the irrigation potential or capability of irrigation works is usually forecast, taking into account the water potential of the source and on the basis of certain accepted average norms and practices as deduced from earlier irrigation experience in similar areas. Thus on canals in Uttar Pradesh, the irrigation potential is worked out on the basis of : (a) the average depth per watering; and (b) the maximum period during which one watering must be given to the principal crop or crops to be irrigated during the fasal. The average depths per watering at the outlet head are taken as:

Rabi	5¼"
Sugarcane.. ...	6½"
Rice	7½"

The maximum period during which one watering must be given in rabi or sugarcane is usually found to vary between 6 weeks to 8 weeks, for the conditions obtaining in ~~the~~ Uttar Pradesh. The maximum period of rice is taken as 2½ weeks.

In a note on the economics of tubewells worked out by the Planning Commission in 1954, it is indicated that the average irrigation done by a tubewell in Western Uttar Pradesh may be taken as under:-

Rabi	240
Sugarcane	120
Other Kharif.. ...	60
Total	420

The same note further mentions that the same pattern would be applicable to tubewells in the Punjab. The discharge of tubewells considered in this note is of the order of 33,000 gallons per hour for sustained, round the clock, working during the period of keen demand.

In the context of Sultanpur area, it was suggested to the Committee that the irrigation requirements might be worked out on the basis of two alternative cropping patterns as under:

(i) Wheat - legumes or other fodder crops - early cauliflower.

(ii) Wheat - legume fodder - maize.

It was further suggested to the Committee on the basis of earlier experience, for similar conditions as obtaining in Sultanpur area that the following irrigation requirements might be reckoned for different crops:

(a) For early kharif from April to June:
2" irrigation every tenth day.

(b) Late kharif (early cauliflower etc.) July to October, Total irrigation 12" excluding rain with the maximum dry period of 12 days between two consecutive irrigations.

p. 20.....

(c) Rabi irrigation requirement: 3" every month.

On the basis of these considerations, it is worked out that if the water output of an irrigation source is one acre inch per day during all the seasons, it should be able to irrigate as under:

(i) Rabi (Wheat)	10 acres
(ii) Early kharif	5 acres
(iii) Later kharif	6 acres.

It would, thus, follow that if the average water output of the well is taken as 5 acre-inches per day during the rabi period, as is indicated by the observations carried out on the Sultanpur well, hitherto, its irrigation potential for the rabi season may be taken as 50 acres. The Committee has as yet no reliable data or observations under working condition, for the water output of the well during other seasons, but the Committee feels that that as a rough approximation on the basis of whatever information, so far gathered, the total irrigation potential of the well may be taken as of the order of 100 acres.

Comparative economics of the well in relation to other feasible schemes for Sultanpur area:

According to the normal practice, economics of all irrigation schemes is assessed on the basis of the cost and direct benefit considerations. The two important factors to be considered from this point of view are: (a) capital cost; and (b) irrigation capability of the scheme.

It had been suggested to the Committee that the economics of the scheme may be assessed on the basis of agricultural production. Although the Committee realises that the real benefit that accrues from an irrigation scheme and its ultimate objective is agricultural production, it feels that agricultural prodiction on the area commanded by the well is not likely to be correct guide of the merits of the scheme because of numerous other factors involved like; use of improved irrigation practices, agricultural techniques, fertilizers, manures, seeds; enterprising nature of the farmers; and assistance and education provided by extension and other similar organisations or services. In fact, when well planned and controlled use is made of these items influencing agricultural production, along with that of water provided by the irrigation source, the benefits from individual items do not merely add up but multiply. The enhanced resultant production in such a case reflects the merits of a co-ordinated ("Package") Programme in

p. 21 ....

Agriculture, and it will not be proper to attribute the extra benefit on account of this integrated programme to any one of the individual items. The Committee does not favour the view that the entire increase in agricultural production may be attributed to the well or to the irrigation water from it.

In the opinion of the Committee, the other technically feasible schemes for the area that may be considered for comparison are (a) open masonry wells with pervious lining, (b) open masonry wells with impervious lining and bottom bored to augment the supplies; and (c) tubewells.

There are already quite a few wells of the type (a) and (b) in the vicinity of the experimental well. It is gathered that the cost of these wells usually varies between Rs. 3,000/- to Rs. 5,000/- though, in some cases, it is reported to have been even much higher.

Discharge observations were made on a few wells fitted with persian wheels and operated by bullocks. These observations indicate the water output on these wells to be of the order of about 0.35 to 0.5 acre inches per day. On this basis and in accordance with irrigation requirement described earlier, the irrigation capability of these wells should be about 7 to 10 acres.

The Committee examined the irrigation performance of a few wells of this type on the basis of Patwari's record. Excluding recent constructions, the wells of this type irrigate about 3 acres of rabi and 2 acres of Kharif. The lower order of actual irrigation performance on these wells may be due to such reasons as : (a) Irrigation is limited by the cultivators holdings which may be very small; (b) It may not be possible for bullock power to carry out sustained running of the wells as the bullocks may require rest after a few days' working and (c) Irrigation and other agricultural practices adopted may be of inferior order and (d) No extension efforts of the order provided on Sultanpur Katcha Well have been made available.

There are also some wells in the vicinity of the experimental well, which are operated by camels and also few others which are fitted with diesel engine pump-sets. Observations made on one of the wells of the former type (belonging to Shri Indraj) indicated that the persian

p. 22 ....

wheel operated by camels was able to give a discharge of about 3,000 gallons per hour. If such a well was operated for 8 hours a day, effective output should be one acre-inch per day. Observations were also made on 2 wells fitted with diesel engine pump-sets. On One well belonging to Shri Ram Phal (given on lease to Shri Ghandu Lal) the discharge of the pump was of the order of 4,000 gallons per hour and the pump-set was operated continuously for 10 hours a day. Water level during pumping went down from 14 ft below the ground level to 28 ft. below the ground level, but the next morning, water level again recouperated fully. On the other well owned by Shri Bhole, the discharge of the pump was of the order of 4,500 gallons per hour. However, one hour's running of the pump depressed the water level from 28 ft. below the ground-level to 44 ft. below the ground-level and the pumping had to be suspended for a period of about 3 hours to allow it to recouperate fully. This well was being run for a total of 3 hours during a day.

As regards possibilities of tubewells, it was brought to the notice of the Committee that a few years back a tubewell was tried in Chhattarpur village, but was not found to be successful. The Committee feels that since the trial of this tubewell, there has been considerable improvement in the construction technique, equipment and design of tubewells. With the availability of reverse circulation rotary rigs, it is now possible to construct tubewells, of much larger diameter, which can draw comparable supplies with depressions of smaller order. In view of these developments, it is quite likely that tubewells may now turn out to be successful in this area, if an attempt is made to drill large-sized (27") bores by means of reverse circulation rotary rigs and to equip these bores with slotted tubes with gravel-pack filters. Tubewells of this type have been successfully constructed in Uttar Pradesh and Punjab during recent years, in tracts which were formerly considered unsuitable for tubewells.

Exploratory Tubewells Organisation of the Government of India had drilled a pilot hole during 1959 in Chhattarpur basin. On the basis of this pilot bore a discharge availability of about 10,000 to 12,000 gallons per hour is indicated in Chattarpur basin. As a result of similar pilot bores carried out in other areas of Delhi Territory, Government of India have

p. 23 .....

already prepared a scheme for the construction of 25 tubewells in Delhi Territory. The proposal includes construction of 5 tubewells in the area under consideration. It was intended to entrust the tubewells completed under the scheme to co-operative societies for their maintenance and operation, and to treat the construction cost of the tubewells as loan to the societies. The implementation of the scheme has been pending for want of organisation of such societies.

The cost of the tubewell under the scheme is likely to range between Rs. 30,000/- to Rs. 40,000/-. With the sustained discharge availability of 10,000 to 12,000 gallons per hour for a tubewell in the area under consideration, it may be expected to have an irrigation capability of about 200 acres.

From consideration of cost benefit ratio, it would thus, appear, that a scheme of tubewells may be nearly 3 times more economical than the other schemes. The scheme of large-sized kutcha irrigation wells and that of large number of ordinary masonry wells, are likely to have more or less a comparable case, although observations made on some open wells fitted with diesel engine indicate a more favourable cost benefit ratio.

Apart from cost and direct benefit considerations, there are also other factors like: type of external power used for lifting water; cost of water lifting; convenience of operation; release of cultivators' bullock power as a consequence of the scheme for more intensive use on improved agricultural and irrigation practices; comparative adaptability of the scheme to the more convenient use of fertilizers and other improved agricultural techniques; nature of the scheme in regard to employment potential; nature of arrangements for maintenance and operation to which the scheme may be amenable; and the socio-economic impact of the scheme on the village community in general; etc. etc., which have a bearing on assessing the indirect effects and benefits of the scheme. It is difficult to make a precise assessment of these benefits, because most of these depend upon the intensity and efficiency of extension efforts made among the farmers and their response and ability in getting together the resources needed to bring about the most profitable utilisation of these resources, including

p. 24 ....

irrigation. Yet, however, the consideration of these benefits cannot entirely be ignored in an assessment of comparative economics. It is possible that in scarcity areas, which suffer from deficiency of water resulting in low level of crop production, a larger irrigation source commanding a larger area may be more likely to inspire the courage and confidence in a large number of cultivators. From its very appearance, such a source may appeal to cultivators as a bigger resource than an equivalent of a number of ordinary surface wells and may, thus, under properly organised drive of extension measures, be expected to lead and activate the farmers, as a group, to invest money in development of resources, whereas, they might be shy to do so, if the source comprised a number of small wells depending on individual enterprise.

Moreover, a scheme with larger water output and larger commanded area is also likely to offer better scope for efficient utilisation of other tools of agricultural production, like: improved seeds, fertilizers, improved implements and better techniques and methods of field preparation and agricultural operations.

From these considerations, the scheme of large-sized kutcha well may be considered to have more merit than the scheme of ordinary small masonry wells; although the merit of the large-sized kutcha irrigation well in regard to operational convenience at high depressions and structural stability is yet to be established. Tubewells, however, have a definite advantage over large-sized kutcha well for while they combine all the benefits of a large-size source, they have the additional advantages of: (a) Convenience of operation even with larger depression; (b) much less requirement of land and (c) greater structural stability.

It may, thus, be concluded that tubewells, if they can successfully be constructed in that area, will comprise the most economical and desireable scheme from all considerations. In Committee's opinion the scheme of tubewells already prepared, should be given priority in the development of area. It is gathered that implementation of this scheme has been pending as it is not being possible to organise cooperative of beneficiaries for maintenance and operation of the completed tubewells. The Committee recommends that a pilot production tubewell may be got constructed in the area at Government expense, through the Central Exploratory Tubewell Organisation as early as possible.

p. 25 ....

If, however, after proper trials, tubewell irrigation is found unsuccessful, and stability of the Kutcha well of the type in question, is established after a few years of actual operation, the farmers in the area may be prepared to invest on the kutcha well even though the cost of construction and irrigation may be much higher than irrigation resources of equal size in more favourable areas.

Claims, views and opinions about different aspects of the scheme.

The original note and the supplementary notes (Appendices I, II and III) submitted by the sponsors of the scheme made certain claims about the cost, performance and a few other aspects of the scheme. The scheme was examined by the Planning Commission and the State Governments who offered their comments (Appendices IV & V) on various aspects. The results of two test observations made in West Bengal were examined by the previous Technical Committee who reached at certain conclusions in their report (Appendix VI), Two Members of the present Committee have also submitted notes (Appendices VII and VIII) giving their views on some aspects of this scheme from the agriculture point of view.

All these views and opinions expressed in favour and against of the scheme mainly cover aspects, that are discussed serially in the following paragraphs. The views of this Committee, who examined these aspects in detail are also given.

(i) Construction cost: In the initial note on the scheme, the total construction cost, including that of the pump-set was stated to be Rs. 15,000/- to Rs. 16,000/-. The supplementary note indicated the cost as Rs. 25,000/-. The Planning Commission, in their comments on the scheme, considered this amount to be on the low side. Government of Andhra Pradesh estimated the cost as Rs. 53,000/-, and Bombay Government as high as Rs. 75,000/-. Governments of Uttar Pradesh and Kerala considered the estimates as very much on the lower side.

On the basis of Sultanpur experience, the cost of the well is not likely to be less than Rs. 60,000/- when cost of pump-house is excluded and sub-soil strata and water table conditions are favourable

p. 26 ....

to construction. Cost is likely to exceed considerably in areas with: (a) good water bearing strata; (b) low depths of water table; and (c) rocky sub-strata below the top soil.

(ii) Discharge of the well: The original contention was that the well of the proposed design would yield the discharge of 1 to 2 cusecs, i.e. about 22,500 gallons per hour to 45,000 gallons per hour. The Planning Commission considered this expectation to be prima facie, on the high side. Most of the States were doubtful if sub-soil water supply to this extent would be available. Andhra Pradesh estimated a discharge of only 5,000 gallons per hour from such wells. Test observations carried out on 2 completed wells in District Bankura, West Bengal indicated recouperation to be less than 400 gallons per hour for a draw-down of 10 ft. to 20 ft.

A Technical Committee, which examined the test observations of West Bengal came to the conclusion that wells of the type envisaged under the scheme may not be expected to give a discharge of more than 1,500 to 2,000 gallons per hour. That Committee, however, had not taken into account the effect of deep borings provided in the bottom of the well as the scheme of Shri Iyengar, which was examined by that Committee, had never contemplated use of such borings.

On the basis of Sultanpur observations, the yield of the well is likely to be in the range of 2,000 gallons to 6,000 gallons per hour varying according to the draw-down heads and seasons. Taking into account the storage of the well, the effective water output of the Sultanpur well may be reckoned as 4-acre-inches to 6 acre-inches per day. It has not been possible to observe as to how much discharge is provided by the deep borings and how much by the rest of the percolation area.

(iii) Structural stability: The Planning Commission expressed doubts as to the stability of such large-sized wells, which were, in their opinion, likely to give way or collapse in course of time. States of Assam and Kerala also expressed similar doubts. The Technical Committee, who had examined the scheme earlier stated in their report "there are chances that in due course that some silting may take place in the bottom of the well with the result that the recouperation in the well may further reduce"

This Committee feels that it is not possible to vouch for the stability of the well unless its behaviour is watched for a few seasons under the actual working conditions.

(iv) Availability of land, free of cost:

The Planning Commission and some of the State Governments considered it doubtful if about 1½ acres of land required for construction of the well would be available, free of cost, in every case. Even in the case of Sultanpur experimental well, the land utilised for the construction of the well was not donated free by the beneficiaries but was part of the "Village Shamlat" land. Favourably situated 'shamlat' land for commanding an irrigated area of the order of 100 acres may not always be available and the Committee is doubtful if land for these wells can always be obtained free of cost.

(v) Scope and utility:

All the State Governments have expressed the view that the scheme is either not at all suited to the conditions obtaining in their States, or the scope is very limited on account of one or more of the following reasons:

(a) Sub-soil water availability is poor,
(b) Sub-soil water table is very low,
(c) Sub-strata consist of rock,
(d) Tubewells are more feasible schemes for alluvial regions where water availability is good.
(e) Filter points are very economical in coastal areas where water is available at shallow depths.
(f) Lift irrigation from rivers and streams is more economical and feasible.

The Committee agrees with these views.

(vi) High charges for irrigation water supply:

The Planning Commission have expressed the view that cost of irrigation under the scheme would be much higher than from flow irrigation and as past experience has shown, cultivators may be averse to pay such high cost. State of Rajasthan have also expressed similar views.

According to the Committee's analysis, the irrigation charges work out to about Rs. 100/- per crop acre for working the scheme on no loss no profit basis. In view of past experience on tubewells and other lift irrigation schemes, it is indeed doubtful if cultivators would be agreeable to pay such high rates.

p. 28 ....

(vii) Chain re-action:

It has been contended that the scheme would set up a chain re-action by yielding an annual return of Rs. 42,000/- against the initial cost of the scheme of Rs. 25,000/- and recurring cost of Rs. 8000/-, and by utilising this return for further investment on an increasing scale. Planning Commission held the view that "prima facie it is considered that it would be a great achievement if the actual cost of service could be recovered from the cultivators. It is most unlikely that any surplus revenue would result for re-investment so as to make a chain reaction".

It appears from the perusal of supplementary note on the scheme dated 2nd June, 1956 (Appendix II) that the annual return of Rs. 42,000/- had been worked out on the basis that irrigation capability of the scheme would be 420 acres. The irrigation capability of the Sultanpur well, however, is assessed to be about 100 acres. The cost of the well is also in the neighbourhood of Rs. 60,000/- and not Rs. 25,000/-. The recurring cost of operation, excluding interest charges is of the order of Rs. 9,000/-.

In view of the above facts, the Committee feels that when the beneficiaries associated with this scheme, are called upon to pay back the loan assistance initially sanctioned by the Government to meet the construction cost of the well, it will be very difficult for them even to pay the irrigation charges for running and operation of the scheme. The Committee do not, therefore, see any prospects of the "Chain reaction" being set up.

(viii) Indirect advantages of the scheme:

It has been suggested that as the scheme of large-sized kutcha irrigation well caters for higher order of supplies, it will have indirect advantages as mentioned under, in comparison with the scheme of ordinary masonry wells:

(a) Providing increased opportunities for constructive co-operation on an intensive scale in regard to various agricultural activities, marketing, etc., resulting in mutual sharing of benefits.

(b) Inspiring courage and confidence and encouraging activity of cultivators, as a group.

p. 29 ....

(c) Greater adaptability to introducing of diverse and intensive cropping pattern and use of improved agricultural practices and implements.

(d) Saving in lifting costs due to larger order of supplies.

(e) Release of draught animals for other agricultural operations.

(f) Saving of water losses in distribution.

The Committee agrees with this view, but feels that these advantages will equally apply to a scheme of tubewells or lift irrigation from rivers and streams. The merit of kutcha well is, therefore, not higher than these schemes wherever they are feasible.

Another indirect advantage that has been suggested is that the scheme will create increased potential for employment during construction. In the Committee's opinion this advantage is considerably off-set by the fact that the earth work involved in construction of the large-sized well is of difficult nature. Moreover, even the scheme of small wells, depending entirely on the local talent will also provide potential for employment.

Overall scope and utility of the scheme:

The Committee feels that although the scheme of large-sized kutcha irrigation wells may be regarded to have some indirect economic merit as compared to the scheme of small wells, the over-all scope and utility of this scheme is very limited because of the various factors and consideration, which are discussed as under:

(a) Geological and sub-soil water table considerations:

The scheme envisages construction of wells as deep as 50 ft. to 60 ft. Construction of wells to this depth would be extremely difficult in the alluvial areas where ground-water flow is good. Moreover, tubewells are generally feasible in such areas and the scheme of large-wells cannot be expected to compete with that of tubewells, in areas where latter are feasible. These considerations would, thus, rule out the possibility of the scheme in bulk of areas in Punjab, Uttar Pradesh, Bihar and quite many areas even in Assam West Bengal, Andhra Pradesh, Madras, Gujarat, Madhya Pradesh and Rajasthan.

p. 30 ....

Thescheme is also not feasible for areas with deep sub-soil water table. Increased cost of excavation in such areas will make the scheme inordinately expensive. Quite a large number of areas, particularly in Rajasthan, and also in Punjab, Uttar Pradesh and many other States would, thus, be excluded from the purview of scope for this type of scheme.

There is little chance of the scheme being successful in Deccan trap and other areas, which are under-laid with rocky sub-stratum within a few feet depth. This consideration would severely restrict the scope of the scheme in the State of Mysore, Madhya Pradesh, Andhra Pradesh, Saurashtra, North Bihar and in many areas of other States.

The scheme has also bleak prospects in laterite and clayey soils, which have very poor ground-water availability. The discouraging response that the scheme has received in West Bengal supports this fact. Large many areas in the country would be ruled out from the scope of the scheme on this account.

The views expressed by the various State Governments on the feasibility of the scheme with due regard to their local geological and sub-soil water conditions support these conclusions.

It would, thus, appear that the scope of this scheme, on these considerations, is limited to some isolated pockets of areas in the country, which may have conditions different from any of these mentioned above. Even in such limited areas, the economic feasibility or advisability for undertaking this scheme would only occur when all attempts, on sound engineering lines, to instal tubewells have failed. Even tubewells of smaller sizes or open-cum-tubewels of the cavity type, if successful, in such areas would be more economical ~~x~~ than, and therefore be given priority over, the scheme under consideration.

(b) High cost of and difficult construction and operation of the well.

The cost of construction as well as operation of a kutcha well of the type under consideration is very high. Construction also involves difficult item of under-water excavation and dewatering. Operation is also difficult and cumbersome as it needs repeated shifting up and down of both the engine and the pump along steep, wet and slippery sides of the well. Running of the engine and pump will always need more attention of an

p. 31 ...

experienced mechanic-cum-operator, than may normally be adequate for a stationary pump-set.

The Committee feels that though the well of the proposed design being a larger irrigation source may have some appeal for the cultivators in the scarcity areas deprived of benefits of canals and tubewell irrigation, yet it is not likely to be popular, in view of the reasons stated above. Its running on self-financing basis will not be possible unless great extension effort is put in to introduce intensive cropping pattern and produce cash crops of vegetables at economic costs by making best use of improved seeds, fertilizers and other better techniques of agriculture and irrigation. In the Committee's opinion, the scheme is likely to have little scope in areas located away from the cities where there may be no ready and favourable market for cash crops of vegetables.

(c) Satisfactory arrangement for execution and operation of the scheme:

Construction and operation of wells of the sizes and dimensions envisaged, by private individuals, is out of question. On the other hand, experience on State tubewells and other State lift irrigation schemes indicates that the execution and the running of this scheme as a State enterprise may be highly unremunerative. The Committee feels, on the basis of past experience, that it would not be possible for the Government to impose an irrigation tariff that may be adequate to defray the cost of operation and maintenance of this scheme and interest charges on the capital investment.

Thus, the only agency that may be considered for entrusting the execution, maintenance and operation of this

type of ....

p. 32...

scheme is the co-operative of beneficiaries. The Committee gathered that no co-operative of beneficiaries had been coming forward to take up the scheme of tubewells, that, as mentioned earlier, had been prepared for areas in Delhi including Mehrauli area in question. This scheme had been prepared on the basis that it would be run by the co-operative of beneficiaries and that the cost of construction of the tubewell would be treated as loan against the beneficiaries.

The Committee, however, recognizes that the organisation of co-operatives in the field of minor irrigation would be desirable and appreciates the attempts that are being made to encourage such co-operatives for the maintenance of old irrigation works like tanks, kuhls and small channels, etc., that originally belonged to Zamindars or Jagirdars and also for distribution of supplies on existing irrigation works. In the Committee's opinion, wherever the cultivators form co-operatives and are willing to undertake construction and the responsibility for operation of the large-sized wells in question after due consideration of its merits and demerits, they may be encouraged by Government through financial assistance, technical guidance and extension service.

* * *

APPENDIX I.

ORIGINAL SCHEME SUBMITTED TO THE PRIME MINISTER IN MAY, 1956.

Note regarding the import from abroad of a million tons of rice and a million tons of wheat as buffer stocks - the possibility of steeping up internal production of foodgrains to the same amount annually beginning with the year 1956-57 - such production being over and above the increases of foodgrain production scheduled under the Second Five Year Plan.

The target for food grains production laid down in the First Five Year Plan has been apparently achieved. In spite of it, recent statements in the Lok Sabha by the Minister for Food & Agriculture indicate that Government is obliged to negotiate for a buffer stock from foreign sources equivalent to a million tons each of rice and wheat per annum with immediate effect. It was also stated that the transaction may have to be on a contract basis for a period of some years.

2. Taking landed costs of rice and wheat at Rs.500 and Rs.400 per ton respectively, this means a diversion of foreign exchange to the tune of approximately 90 crores of rupees per annum on purchase of foodgrains. As this position has developed at the end of the First Five Year Plan period, it may contime to be a recurring drain on foreign exchange for some years to come, even allowing for implementation of targets of the Second Five Year Plan.

3. In his article in the All-India Congress Committee Economic Review dated 1.4.1956 Sri Sriman Narain has expressed his justified anxiety that "th poor hardly seem to have got any tangible benefits from the existing Plan, even in the Community Project Areas. While the rich seem to be getting richer". This is the position even though national income has gone up by 10% within the First Five Year Plan period.

4. The incidence of this poverty is more actually felt in rural areas. Besides, increase of wealth in other hands - as shown by the total increase in national income - relative reduces the quantum of foodgrains available to poorer people while it increases the price of such foodgrains through market activities controlled by more affluent persons.

5. The need for buffer stocks is, therefore, likely to last for some years for toning prices, and for supplementing natural or artificial shortages.

6. The need for radically improving the condition of the poorer sections, the bulk of whom live in the villages, as a stabilising factor in the internal economy of the country, is even more vital, though in its present context is may not appear to be as pressing as the urgent acquisition of abuffer stock.

7. The import of 2 million tons of foodgrains entails a foreign exchange of nearly Rs.90 crores every year. If this can be saved by a special effort to step up internal production to the extent of 2 million tons supplemental to the increase contemplated in the Second Five Year Plan, valuable foreign exchange to a corresponding extent could be utilised to better purpose than in purchasing from outside what could be produced locally. The sooner this is done, the greater the saving, though it is realised that for the present year import seems inevitable. The question is how soon can such import be obviated. It seems possible to achieve this extra production within a year.

8. Furthermore, such production may be planned as a development work in backward agricultural areas, highly suscestible to loss of crops due to vagaries of rainfall. Such areas are a constant financial burden to State and Centre. Their development is, therefore, all the more economically advantageous. It makes the poor a little richer.

9. The West Bengal Government Report on the "Relief of distress in the State from January to July 1955" mentions a deficit of nearly 1½ million tons of rice valued at approximately 68 crores of rupees between the 1954-55 crop

P.T.O...

and the earlier crop of 1953-54. It attribues the loss to natural calamity, namely, flood in some and famine in other parts. It says "Improved seeds, fertiliser, labour and all aids to agriculture where available - only Nature's assistance was lacking. Gove optimum natural conditions, there was no reason why production should not have reached previous year's level". Elsewhere, it mentions that "Meteorological imbalance is the most important single factor which undermines agricultural efficiency in West Bengal. Inadequate and ill-spaced fall of rain will bring about near-desert conditions in parts of Bankura and North Midnapore".

10. These two districts themselves accounted for a fall in production of nearly 6 lakhs tons of rice. The loss to the people was about 28 crores of rupees in a single year and all for lack of timely rain only. The resultant impoverishment of the countryside can be imagined. Relief measures cost Govenment over 4 crores of rupees.

11. As uneven rains reduced the yield of rice in the State of West Bengal by as much as 1½ million tons in a single year, then either normal rainfall or due conservation or supply of water for irrigation should in itself suffice to step up production by an amount lost by drought.

12. Published figures of increase in yield due to the Japanese method of cultivation show 12.7 maunds of rice per acre for West Bengal as the extra yield.

13. Irrigation is estimated to increase the average yield of rice by 5 to 9 maunds per acre, as shown in the D.V.C. and the Kangsavati Reservoir Project estimates respectively. Winter crops are estimated by them to yield 12 to 15 maunds of wheat per acre when properly irrigated.

14. Where land can be assured of irrigation both for "Kharif" and for "Rabi" cultivation, the above justifies the hope that increased yield per acre may amount to 1 ton of foodgrain per year.

15. Prize Competition yields in India Crop Competititions have figures as high as 90 maunds of rice per acre, and 70 maunds of wheat per acre. If irrigation is ensured throughout the cultivating seasons of both 'Kharif' and 'Rabi' the achievement of an extra yield of a ton of foodgrain per acre per year is, therefore, quite a practical proposition.

16. In considering the question of cost of irrigation schemes required for this purpose the D.V.C. offers some useful comparative material. The first phase of operations of the D.V.C. seem to amount to about Rs.85 crores. Leaving out power and flood Control costs as amounting to Rs.55 crores approximately, about Rs.30 crores of 'Rabi' crops. The additional annual crops yields through irrigation is schedule in D.V.C. Reports at 56 lakhs maunds of rice and 36 lakhs maunds of winter crops. This amounts to nearly 2 lakhs tons of rice and 1 1/3 lakhs tons of winter crops. The irrigation cost works out to Rs.300 approximately per acre irrigated. An investment of 30 crores of rupees on irrigation works, to give an increased production of 3 1/3 lakhs tons of foodgrains annually, evaluates to a Capital investment on Irrigation Schemes at Rs.900/- for securing an increased annual production of one ton of foodgrains.

17. The Kangsawati Reservoir Project in West Bengal is yet in its preliminaries. The "Kharif" area is 8 lakhs of acres and its Rabi area is 1,50,000 acres, to be covered by irrigation within 1966, that is 10 years from hence.

18. Taking increased wealth in terms of D.V.C. figures of increased yields per acre irrigated, we get 1,60,000 tons of rice and 60,000 tons of winter crop as likely increased annual crop yield. This is about 2,20,000 tons of increased foodgrains in all. This scheme is scheduled to cost approximately Rs.22 crores in irrigation.

19. It works out to an investment of Rs.1,000 on capital cost of irrigation scheme for producing one extra ton of foodgrains per year. The cost for the irrigation scheme works out to about Rs.300 per acre irrigated. It is possible that in the Kangswavati Scheme there may be increases over the present estimates of cost, same as in D.V.C. where preliminary estimates have been considerably exceeded as execution has advanced and new factors encountered.

P.T.O...

20. Of the increased output of foodgrains in the Second Five Year Plan 4.2 million tons are shown as the likely extra yield by the end of the Second Plan period through irrigation itself. Such irrigation is scheduled to irrigate by the end of the Second Plan period 14 million acres over and above that irrigated up to the end of the First Year Plan. Of this again 9 million acres are to bebenefited under Minor Irrigation Works like wells, tanks, etc.

21. An increase of 4.2 million tons foodgrains by the irrigation of 14 million acres works out to an extra yield of approximately one ton of foodgrain for every three new acres irrigated. This is the same as an increase in annual production by 1/3rd (one-third) of a ton of foodgrain per every acre newly irrigated.

22. The cost of irrigation for 14 million acres to be brought under irrigation comes to Rs.300 per acre of irrigated land, the figure being based on D.V.C. and similar schemes. A similar rate of Rs.300 per acre irrigated is given by dividing the capital investment on Irrigation in the Second Five Year Plan by 14 million acres. A capital expenditure of Rs.300 per acre irrigated seems to be a fair average rate of expenditure on large or medium sized Irrigation Works. The excavation of new tanks for Kharif irrigation also costs Rs.300, and sometimes more, for each acre newly brought under irrigation. Even inadequate re-ecavations of old tanks cost not less than Rs.100 per acre of irrigated land.

23. A capital investment of Rs.1,000 on Irrigation Schemes for securing an increase of annual yield by one ton of foodgrains as in the case of the River Valley Schemes and other schemes of irrigation seems to be a fair average. The same figure of Rs.1000 per ton of foodgrains increase is given by dividing the total likely investment on Irrigation Works in the Second Five-Year Plan by the expected total increase in foodgrain production of 4.2 million tons.

24. On this average basis, to produce 2 million tons of extra foodgrains per annum an investment of 2,000 million rupees would be required normally, i.e., 200 Crores of rupees.

25. Also on the basis, shown in para 21/above six million acres of land will have to be placed under irrigation of the normal type, e.g., river valley or tank schemes, to yield annually an extra 2 million tons of foodgrains.

26. A scheme which could achieve a target of 2 million tons of foodgrains per year, by utilising only 2 million extra acres of land instead of six million acres normally required, should be a very good economic proposition in any situation. This is all the more so in a country which is short of land for cultivation.

27. Its economic value is all the more when this extra annual production of 2 million tons of foodgrains can be secured with an investment on irrigation amounting to 60 crores of rupees only instead of 200 crores of rupees normally required for such increase of production through irrigation (vide. para 24).

28. Such scheme would conserve both land and money, each triple fold.

29. During the Summer of 1955 in the District of Bankura in West Bengal a number of Large Irrigation Wells in the relatively more and chronically famine-ridden areas were taken up for excavation as a part of Test Relief Works. Experience showed that while capable of satisfutory execution through local labour such Wells could irrigate both Sumer and Winter crops to quite a fair extent. The cost of construction varied from Rs.8,000 to Rs. 16,000 depending on soil, depth of the sub-soil waterlevel below the ground, the areas as well as the lie of the land to irrigated.

30. A flow of one Cusec of water at least was indicated in completed cases. The flow was good both in Summer and Winter. The accepted ratio

P.T.O...

in irrigation schemes of river valley and similar types is ninety (90) acres of irrigable land per Cusec flow.

31. Making a conservative estimate, it seems quite possible from ascertained results of well Irrigation in Bankura District, that 50 acres can be provided with irrigation satisfactorily to raise both a Kharif and a Rabi crop from each acre. This irrigation is obtainable from a well whose average cost would be about Rs.12,000 for the excavation.

32. Excavation can be done with ordinary implements used by rural labour in earth cutting. No masonry work is required in the well construction. The method of excavation is simple and safe. It is capable of adaptation readily for such expansion or deepening of the Well as may be required for a reasonable flow of water sufficient to cover the irrigable Block.

33. The installation of pumping equipment and supply lines costs a further Rs.3,000 per well. With Electric Power available this cost would be reduced.

34. The yield of Kharif (Paddy) was noticed on measurement to be triple that of neighbouring un-irrigated areas. Rabi Crops were grown on the same lands, to the great satisfaction and joy of the villagers as such crops were grown for the first time in their living memory on these lands. Hitherto they had been accustomed to nothing but a sinle and attenuated paddy crop on such lands during the rainy season, and even this was often a total failure due to porous soil, a sloping terrain, and untimely or inadequate rainfall.

35. The yield of extra foodgrains through assured Kharif and Rabi irrigation from a large Irrigation Well, can reasonably be expected to be stepped up by a ton of foodgrains per annum per acre. There would in addition be scope for cultivation of short term crops including green manure, pulses, oil seeds, fodder or summer vegetable crops. If the necessity for the increase of foodgrain production temporarily eases for a season or period, there is scope for varying the crop patterns to include the switching over to the cultivation of cash or utility crops like jute, cotton, tobacco, potato, sugar-cane, etc. There is scope for introducing effective and profitable Crop Rotations.

36. Taking a block of 50 acres or so of contiguous land, of average or even poor quality, an Irrigation Well and Pump and fittings would cost approximately Rs. 15,000 and provide irrigation to the entire block in both the Kharif and the Rabi Seasons. The capital cost works out to Rs.300 per acre irrigated.

37. The increased production of one ton of foodgrain per acre in the areas irrigated by the well would mean that capital investment on the irrigation work for securing the production of one ton of extra foodgrains per annum would amount to only Rs.300. This is less than even 1/3rd of Rs.1,000 per ton which is the average capital investment under irrigation schemes of both the Five Year Plan for every extra ton of foodgrain production.

38. To secure an increase of 2 million tons of foodgrains we need to irrigate through large Wells 2 million acres only of land, as against six million acres of land to be irrigated under major or multi-purpose schemes & normal or minor medium scales schemes.

39. The capital cost on Irrigation Wells required for this increased annual production of 2 million tons of extra foodgrains (by the irrigation in both Kharif and Rabi Seasons of an area aggregating to 2 million acres of cultivable land), comes to 600 million rupees only, at Rs.300 per acre irrigated by a well costing Rs.15,000/- and serving 50 acres for both Kharif, and again for Rabi cropping.

40. The above 60 crores of rupees required in the construction of sufficient Wells to irrigate 2 million acres of land cultivated or fit for cultivation includes a cost of Rs.12 crores for the purchase of Pumps and fittings.

41. It is possible that the figure of Rs.48 crores for excavation of the Wells may be reduced under favourable conditions of increased sub-soil water supply. For instance, if the flow in the well comes upto two Cusecs, about double the area can be irrigated from a well of the same dimension as one giving a flow of one Cusec only. There are areas where such increased flows have been observed. The size of the block to be irrigated is somewhat elastic depending on such factors, and the cost of a well can also vary somewhat because of them. If due to increased

flow of say 2 Cusecs instead of one Cusec from a well excavated with rupees 15,000/- as cost inclusive of Pump, about hundred acres can be given irrigation for both crops separately instead of only 50 acres, than the capital cost of the irrigation scheme equates to Rs.150 only per acre irrigated throughout both the Kharif and the Rabi season, To meet the increased flow the only change needed would be a higher calibre pump of corresponding power costing about Rs.1,000 more than the other pump.

42. The value of the additional national income from 2 million tons of foodgrains would be Rs. 80 crores annually. The expenditure of Rs. 60 crores as a capital investment on irrigation for such production is well worth it. It saves foreign exchange of nearly Rs. 90 crores annually on foodgrains imports. It adds an almost equal amount to the annual national income. It gives work and relief, reduces inflationary trends, and helps increased per capita consumption of foodgrain. It steps up through increase in production the per capita income of benefited agriculturist families by nearly Rs. 400 per capita per annum, as agricultural land in West Bengal is about 1.16 acres per capita of families dependent on agriculture. It paves the way for vastly increased employment and prosperity for the associated rural labour, artisan and other classes in and around the benefited areas. It helps to stabilise prices of foodgrains elsewhere in the country and food deficits. It raises the quota for per capita consumption of foodgrain by about half an ounce within the end of the first year itself of the second Five Year Plan, as against the contemplated target of increase of per capita quota of foodgrain consumption by one ounce by the end of the Second Five Year Plan period, as envisaged in the second Five Year Plan.

43. Against an estimate of nearly Rs. 480 crores, in the Second Plan on Irrigation and Power Projects, to yield an increased 4.2 million tons of foodgrains by the end of the Second Five Year Plan period, an expenditure of Rs.60 crores only would help to secure an increased annual production of 2 million tons of foodgrains starting with the very first year itself of the Second Five Year Plan.

44. An import of 1 million tons of rice at prices about Rs.500 per ton and its sale at the usual subsidised rate of Rs.400 per ton (Rs. 15 per maund) would result in a loss to Government through subsidy of an approximately Rs.100/- per ton, and therefore, of Rs. 10 crores annually on one...

million tons of rice. Wheat transactions are not taken into account as there is no international wheat agreement yet in respect of the 1 million tons of wheat proposed to be imported annually for some years.

45. The expenditure of Rs 50 crores on capital cost of Irrigation Wells could be set off against this loss through subsidy over a period of 5 or 6 years entailed by the import of foodgrains from abroad. It could also be set off against recurrent famine relief charges by concentrating such irrigation works in the poorer areas of the country fit for such development and speedily executing them. Such poor areas have a correspondingly large unemployed labour strength which may in this case be utilised to general good purpose, both as immediate employment measure as well as a mean of creating facilities for further employment in progressive rural economy.

46. These wells are preferably sited in areas not likely to be benefitted by other forms of irrigation in the immediate future. Such sites are available in the higher and more arid undulations of the Bankura and Midnapur Districts of West Bengal and in similar areas elsewhere like the Santal Parganas in Bihar and similar tracts in Orissa, to mention a few at random.

47. In Bankura District over a hundred well sites were offered in the course of a few weeks in 1955. This showed the faith and hope of the cultivators in its value, as well as their urgent need for irrigation to convert land lying most unproductive or poor in return into a useful crop-bearing one. More sites would be available if the matter is pursued. About 3 to 4 lakhs acres of land relatively poor in production now but capable of good yields would be available. Other districts and States may furnish the balance of the 2 million acres.

48. These are lands least likely to be benefited by River, Stream, or Tank irrigation schemes. They are on slopes, or above the valley portions. Hence their owners will have a greater urge to benefit by well irrigation as the only possible source of improvement. They are also the hardest hit cultivators now, with little prospect of improvement in their agriculture from any major or minor irrigation scheme to date.

49. In Bihar itself over 24 lakhs of acres are stated to have been donated to Shri Acharya Vinoba Bhave. In Orissa several villages and many acres are reported to have been similarly given as Bhoodan. It is possible that some of these lands are marginal for cultivation. Irrigation may, however, change their complexion remarkably.

50. To secure 2 million acres of poor quality lands for improvement through well irrigation should not therefore be difficult, specially as no owner will be disturbed in his right or possession but only assisted to improve his produce. Wells may also be sited with advantage in areas where there have been Bhoodan gifts, as a ready means a development for helping the landless or poor labour to cultivate them profitably and thereby rehabilitate themselves. This would bring waste, or hitherto less productive, land under better cultivation, as much as it would provide landless people with cultivable land on a workable basis, to the ultimate common advantage of all. It would provide an opportunity - through concentrated and purposeful work - for constructive co-operation on an intensive and

progressive scale between the people, public-spirited thinkers and workers, and Government Administration. Through such co-operative contact, mutual understanding and confidence could grow, and in its turn egender integrated progress on strong, balanced, and healthy lines.

51. A solid pace for a start to co-operative thinking on the part of villagers lies in their common adversity, and the provision of a common source of irrigation as the greatest single factor in overcoming such adversity. The necessity to maintain and work the irrigation pump in harmonious rotation encourages and induces co-operation in other directions also. The well acts as a token of hope to a bleak and often parched countryside. Through its help agricultural prosperity is more promising, with richer community life as a corollary.

52. The procedure for achieving the target of 2 million tons of increased foodgrains p.a. with outlay of Rs 60 Crores within this year is a simple one and easy of understanding, adaptability, and application. Three things are esential:

(i) A block of cultivable land about 50 to 100 acres in extent, with fair prospects of sub-soil water within 20 to 40 ft. of ground level in the rains and in winter as in Bankura and Midnapur Districts.

(ii) Resources in labour for excavation purposes.

(iii) Resources in money for cost of excavation and installation of pump and fittings.

The first two of these items are fairly available. The third has to be met by Government in view of the abject poverty of most of the inhabitants.

53. In Bankura District, groups of persons owning or cultivating in a block of this pattern joined up to petition for the sinking of a Well as part of Relief works. The lands were of medium and poor quality. Three conditions were entered into:

(a) Land about 2 acres in extent was donated outright for excavating well and forming its tank and boundry.

(b) The cultivators agreed to Government guidance in respect of forming supply channels for irrigation, and utilising water for irrigation co-operatively and to purchase a pump and fittings with Government loan and Government grant on a 50:50 basis if possible.

(c) The larger owners agreed to place a unit or two equal to 1/10th of the total irrigable area at the disposal of the Government for 10 years for utilising in the interest of the villagers, including trial and demonstration of improved agricultural and horticultural practices, or cultivation by landless or poor cultivators with shares laid out for common purposes, as for instance reduction of loan, village charity, depreciation, reserve, etc.

54. As these areas gave very poor yields, from practically nothing at times to about half a ton of rice in the most favourable year of rainfall- which again occurred about once in 4 or 5 years - an assured crop of

even half a ton of rice per year would be more than double the average yield of crop over a quinquennial period without irrigation. In other words, the production of their land having more than doubled through irrigation, and what was at times waste having now shown promise of providing productive, the larger owners - whose poverty hitherto was only relatively less but not altogether absent at times of scarcity - had no hesitation in sacrificing 1/10ths of their total area under irrigation for the common interest including their own, as the balance of 9/10 was as good in a productive sense as a 9/5ths of the original area. To be more explicit an owner having 10 acres might have got in 5 years a production of say 3 tons, 2 tons, nil, 5 tons, 4 tons of rice from 10 acres of his land. This totals to 14 tons in a quinquennial period. With irrigation he should expect an assured crop of 9 acres only of 4½ tons of rice each year for every year of the quinquennial period. This totals to 22½ tons. A sacrifice of 1 acre for a period of 10 years would therefore not harm him really, weighted against the resuscitation of his entire land through irrigation.

55. With this secure base for cooperative endeavour through close and neighbourly groups of cultivators, it is possible to concentrate technical assistance and guidance in scientific farming practices and new industrial techniques, (as, for example, soil conservation, horticulture, sericulture dairy farming, fodder growing, silage making, poultry keeping, apiary, fish culture, storing and processing of agricultural produce), all within the villages themselves. The introduction of new small or medium scale industries on cottage or village levels would also be easier. They could be Hand or Power driven as expedient.

56. "Integrated Cooperative Development Projects" based on the recommendations of the All-India Rural Credit Survey Report (1954) could be woven into the local settings.

57. Cooperatives could develop for the following purposes based on closely knit groups either working as individuals, or in groups, or in unison with one or more further groups, according to necessity and economy:-

(1) Irrigation
(2) Production, purchase, distribution of high quality seeds and fertilisers.
(3) Dairy farming and upgrading of cattle and fodder raising
(4) Poultry keeping and upgrading poultr
(5) Apiaries
(6) Fish culture
(7) Sericulture
(8) Horticulture and fruit farming
(9) Afforestation, soil conservation, reclamation of land, and growing of fuel and timber and other economic trees.
(10) Credit facilities
(11) Savings
(12) Rural marketing
(13) Consumer stores
(14) Ware-housing
(15) Storage of raw agricultural goods, implements and supplies.
(16) Processing agricultural goods and their grading and storage
(17) Cold storage
(18) Making improved agricultural implements
(19) Producing more goods having fair local demand like

(a) Stone-ware

- (b) Brass and Bell metal works
- (c) Pottery
- (d) Porcelain
- (e) Cotton ginning, spinning and weaving
- (f) Silk rearing, reeling and weaving
- (g) Jute spinning and Weaving
- (h) Mat and basket making and rope making
- (i) Oil pressing and soap making
- (j) Leather and shoe industry
- (k) Rice husking, gram and wheat crushing
- (l) Match industry
- (m) Blacksmithy, tin and copper smithy, gold and silver smithy
- (n) Sugarcane crushing, gur and sugar manufacture extraction of alcohol from molasses
- (o) Fabrication of wooden fittings and furniture
- (p) Fabrication of steel trunks and buckets
- (q) Paper making
- (r) Conch-shell industry
- (s) Bidi and cigar manufacture
- (t) Manufacture of minor chemicals and pharmaceuticals
- (u) Small scale printing for groups of villages
- (v) Tile and brick making
- (w) concrete block manufacture
- (x) Other Medium scale, village or Cottage basis industries.

(20) Rural housing
(21) Sanitation and health centres
(22) Basic education with small scale engineering workshops for training into artisans
(23) Social education, recreation, sports, and cultural activities like folk songs, dances, dramas etc.
(24) Communications like roads, culverts and small canals.
(25) Transport.
(26) Motor Mechanics and Repairs.

58. Many other items could be introduced. The already advancing supply of Electric Power to the Villages from the great Multi-purpose and other Power projects in the First and Second Five Year Plan would help also in the wide and rapid development of the manufacture of decentralised parts of Machinery and of Engineering Industries, as in the case of Japan and Switzerland. It would facilitate electrical and electrolytic processes.

59. These sufficiently indicate the enormous scope for development and ever-increasing employment potential inherent in the scheme. The emphasis here is on Production of Wealth in the Countryside from Agricultural Resources first. This in turn will lead to Industrial Development by investing therein wealth obtained from Agriculture. At the same time the asset of calm and pleasant family and rural surroundings will be preserved.

60. The increased production of wealth is to be achieved through Cooperatives of people living close together, and progressively widening their activities, and correspondingly opportunities for employment. Government agencies and public spirited persons will find useful field for coordinated, pleasant, and purposeful service in advancing such development with their advice, assistance and resources, as may be most helpful and constructive.

61. With the objective clearly defined and the value of each person's contribution understood in its context, coordinated endeavour towards such objective will acquire a more forceful meaning, and generate a greater momentum for its achievement.

62. It is not necessary to state in detail here how each Cooperative is to be formed and worked. The availability of cheap power may induce and encourage the setting up of small Rural Work Centres on a Village basis with implements adopted thereto in respect of some industries. The Cottage basis for certain industries may prosper too. Medium scale industries for a group of villages could be set up also.

63. There is nothing rigid over here. Both village, Cottage and Medium scale Industries are possible and can flourish side by side. Economic and technical considerations would weigh most, with individual and general progress as the prime objectives to be kept in view always. Administrative Departments as well as non-official Organisations of repute have drawn up a number of excellent schemes based on experience. These could be fitted into the picture as soon as irrigation assures the cultivators of a good crop.

64. To mention a few of such schemes, we have those for cooperative Marketing, Credit, and Ware-housing; for integrated Cooperative Development; for live-stock improvement, horticulture, poultry, etc. These are drawn up by Government Departments. Then there are schemes for Minor and Cottage Industries drawn up by the All-India Cottage and village Industries Board, The Indian Cooperative Union, and similar organisations, who have extensive field experience. Industries Departments of Governments have their contributions also. The essential thing is that there is room for all in an underdeveloped economy. There is ample scope for heavy, medium and small scale industry flourishing without conflict, each in its due place. Equally there is room for developing rural economy as much as urban economy, with no conflict between them. What is primarily urgent is that we should have sufficient production of such articles as food and cloth to meet the immediate needs of people, and ensure its reaching them when needed, even if unemployment and under-employment persist for some time, till new avenues of employment absorb them, whether in the villages or in the Towns the fields or in the Factories, Establishment and Institutions.

65. To sum up, the present note contemplates the initiation of an immediate attempt on a coordinated level through the Central Government and State Governments to raise the output of Food grains within a year by 2 million tons apart from increases contemplated by the end of the 2nd Five Year Plan, with a Government expenditure of 60 crores of rupees on capital cost of irrigation of 2 million acres of land. The immediate obvious advantages are listed below:-

(1) Saving of foreign exchange on the import of 2 million tons of foodgrains costing about rupees 90 crores per annum, for some years to come.

(2) Increasing per capita income within the country by enabling an extra production of 80 crores of rupees worth of foodgrains each year commencing from 1956-57.

(3) Providing immediate employment of a simple and uncomplicated nature for some of the poorest and most backward agricultural communities for their early and permanent development. Its psychological effect would be most valuable.

(4) Increasing within a year the per capita income of such communities by nearly 200 per cent with promise of further increase progressively.

(5) Acquisition and maintenance of buffer stock within the country on easy terms to people and Government alike. The Cooperative Marketing and Ware-housing Societies could profitably take up this work.

(6) Diversion of agriculture from food-grains to cash and utility crops in case Government has enough buffer stocks to carry over.

(7) Providing scope for rehabilitation purposes through utilisation of waste or unproductive lands and banishing poverty and squalor from such areas;

(8) Saving on recurrent relief expenditure;

(9) Minimising later development costs in these areas;

(10) Making good drinking water available through these Irrigation Wells, with scope for farming and kitchen gardening;

(11) Development of powerful consumer potential for electric energy in rural areas;

(12) Forming a firm basis for progressive and all round Cooperative development of Agriculture, Industry, Health and Education in the area covered - in other words for Community Development and Integration on a wide and intensive scale. Calm and quiet sylvan settings would provide an atmosphere for basic education both in the Arts and in the Crafts as in "Santiniketan". Industry would flourish in healthy and peaceful homely surroundings, an advantage often denied to labour crowded into cities and towns;

(13) Providing an opportunity for active, close and friendly understanding and cooperation between the people, their Representatives in the Legislatures and Parliament, Social Workers, Students, Public Organisation, and Govt. Agencies, in the study and solution of rural problems of areas inhabited by large proportions of poor, backward, or aborginal classes.

66. These conditions are by themselves sound enough to warrant an attempt to achieve them. During this attempt about 10,000 Small Cooperatives will start functioning and form a rich source of steady work and wealth.

67. The increased income of the community itself should be sufficient to provide reasonable standard of welfare services in respect of Health, Education and Communications and Transport and Housing. About 200 crores of rupees have been allowed in the Second Five Year Plan on Community Development Projects covering about 300 million people. The present scheme may cover about 3 million people. The proportionate investment on 3 million people for community Development under the Second Five Year Plan may be about Rs 2 crores over a period of 5 years. With an increased income of nearly 80 crores of rupees per annum, there should be no difficulty in this area meeting its own community development requirements on a far more impressive scale, year after year from the end of the very first year of the Second Five Year Plan.

68. The attempt is all the more worthwhile in this age of intensive hope and achievement. It is even more so when the pathetic condition of the area and of the people to be helped is visualised. Government reports describe the district of Bankura and portions of North Midnapore "as extremely backward in every respect". The lands have "become semi-arid tracts which may aptly be called 'dust-bowls' and 'gravel-bowls'." It also says that "poverty of the people has reached a limit which is appalling". How appalling this poverty is can be gauged from the fact that in the 1955 relief works over a lakh of people out of a total population of nearly 13 lakhs in Bankura district, managed to live on a pathetic pittance of 2 seers rice a week equal to Rs. 4 per month for an adult and Rs.2/- per month for a child, given as gratuitous relief of persons unable to work and having no other means of subsistence. Poverty of these people has become a second nature to them, and they live in its constant and harrowing shadow. Similarly nearly 50,000 labourers and small cultivators worked on Test Relief Works for days together in the hot summer at little more than 10 to 12 annas wages a day and often even less, obliged to work in trying conditions by the absence of any other means of subsistence. Some migrated to other districts for work. In fact such migration of thousands of people has become a seasonal even for years past in these regions due to the severe pressure on land and its diminishing productivity. These migrations of helpless families desperately seeking work, and going long distances in sun or rein with their little children and belongings tied to their back, or carried in baskets strung across their shoulders, and heart-rending in the poignancy of their misfortune. To them it seems to know no redress.

69. It is also recorded that during the recent visit in January 1955 of Acharya Shri Vinoba Bhave to these areas he was "appalled by the poverty and squalor of the villagers who are steeped in darkness and incapable of leading a healthy existence". He found most of the huts could not even afford the luxury of an oil lamp for illumination, not to talk of electricity which is a far cry undreamt of and incompatible with the present economic conditions in this extremely backward part of the country. Acharya Bhave made a fervent appeal to the authorities concerned to make an earnest effort for the amelioration of distress of these unfortunate people who deserve at least a minimum wherewithal for a civilised existence by providing facilities for irrigation which is their primary and immediate need."

Similar areas exist in neighbouring Bihar and Orissa with like problems of agricultural impoverishment. A large percentage of Backward and Aborginal Classes is found in the population. Though the annual rainfall is about 55 inches on an average the undulation of the soil, fast run-off and [illegible] nature of the precipitation jeopardises crops repeatedly. Sub-soil water is a very promising source of irrigation the level ranging from 4 to 5 feet up to 30 feet below ground level depending on soil and season. A few Artesian wells are in existence of recent origin and show good sub-soil water potential.

70. These areas are in need of development most. The remedy is as simple as the problem has been hitherto alsmost intractable. It is to provide a net work of Large Irrigation Wells capable of irrigating both Kharif and Winter Crops. Each Well will suffice for a block of about 50 to 100 acres of cultivable or cultivated land, inclusive of marginal, unproductive or hitherto waste land left idle due to lack of irrigation facilities, but having good agricultural potential.

71. To cover 2 million acres of land not served by irrigation now about twenty thousand (20,000) to forty thousand (40,000) such Wells may be required. The cost will be about 60 crores of rupees for excavation, pumps and fittings. The work as noted earlier will be done by indigenous and available labour, entirely with ordinary implements. No masonry work is involved in the Well construction.

72. The Diameter of the Well which is Conical in shape ranges from 160 ft. to 200 ft. at ground level The excavation continues maintaining a slope of 2:1 (2ft.horizontal : 1 ft. vertical) upto a depth of 25 ft. below ground level. Thereafter excavation proceeds to a further depth of 25 ft. more with a slope of 1:1 (1ft.horizontal : 1 ft. vertical). This leaves a bottom diameter of 50 ft. at a total depth of 50 ft. from ground level. This is generally sufficient. An extra depth upto a total of 60 ft. from ground level could be secured by continuing the excavation with a 1:1 slope for a further depth of 10 ft. beyond the 50 ft. depth which is normally sufficient. This would cost about Rs 1,000/- more than the cost of excavating a Well up to 50 ft. depth only.

(N.B. A separate estimate is attached based on rates of excavation allowed in experimental Well Constructions for irrigation purposes in Bankura District.

Similar conditions apply in neighbouring regions.

73. The work is highly and essentially decentralised by its very nature. During the process of excavation it will give much needed assistance to un-employed and under-employed people in villages. It is easy of local understanding and execution. It requires no technical skill. Such supervision and guidance as is necessary can be provided by local talent.

74. It requires only Blocks of land about 50 to 100 acres in extent for each self contained project of an irrigation well irrigating that block. The unproductive nature of land and uncertainty of crops thereon unless irrigation comes to the rescue is an automatic incentive to agriculturists to secure the benefits of irrigation Wells, on a wide and intensive scale. This will also spur them to forego a small portion of land for the Well, and for general village advancement including their own. This portion is likely to come naturally from

those owning the largest portions of lands in the irrigated area or near about, as they expect to benefit most by this irrigation, the advantage of better crops on the areas retained by them for outweighing their comparatively small individual loss on the small portions of hitherto poor lands foregone by them for the well, and for general village advancement.

75. A Govt. grant for excavation and pump and fittings will be needed for each Well, at Rs 15,000/- per Well. Indigenous labour will carry on excavation assisted by a few local literate or educated people in maintaining measurements and accounts of payments and submitting returns. These are elementary in nature. As their future economy is intensively associated with the irrigation Well the villagers themselves will be anxious to see to its proper execution. Further supervision could be readily provided through Government sources as well as responsible non-officials.

76. To the extent these will be forthcoming advance is assured. There is no reason to fear failure. Even if some wells only are offered first and executed they will spur others to come forward in much larger numbers. This is found from experience. Even part execution will provide some irrigation to start with, at least or Kharif, while further excavation can be carried on alternative with limited irrigation till a good flow is secured, say at depths varying from 40 ft. to 50 ft. Nothing is lost through these excavations. On the other hand progress and improvement will be steadily a growing and continuing process.

77. The work can be done utilising existing District Administrative machinery geared to the requirement, coordinated Central and state guidance and assistance,- with local initiative and co-operation playing a big, active and enthusiastic part in its own advance. The help of social and public organisations and institutions and of social workers and public-spirited people will be invaluable, and readily forthcoming.

78. What is needed is drive, understanding, sympathy and a spirit of service. Fortunately we are rich in these. We should succeed if we are satisfied that the objective is worth the attempt, and we are determined in achieving it with speed and method. Staff and workers of the Bharat Sevak Samaj, the All-India Sarva Seva Sangh, the Harijan Sevak Sangh, the Gram Udyog Board, the Indian Co-operative Union, and other organisations associated with the people's welfare in various spheres of work could all mobilise efforts in the direction of popularising the scheme, helping in the formation of Blocks and siting of wells, and assisting in watching the progress of expenditure and execution.

79. From the Government side what it needs is an understanding to pool Central and State resources in finance to the limit of Rs 60 crores this year. Three States may be involved in the first instance, namely West Bengal, Bihar and Orissa. Each can work exclusively in its own area, each well excavation project being a self-contained one.

80. Sources of finance could be from Minor or Major or Medium irrigation heads, the ultimate advantage through irrigation being similar. They could also be a part of deficit financing of equated subsidy on foodgrains, of the savings on anticipated foreign imports of foodgrains in this or in later years, or from equated margins of profit on local procurement by Government from the benefitted area on easy

terms to Govt. and growers alike and its sale elsewhere. Relief expenses likely to be incurred in the immediate future could be usefully capitalised here as a preventive step which will obviate the need for recurrent charges on this account subsequently. So also could part of charges ear-marked for Community Development Projects or National Extension Blocks, for Backward Class development, for land reclamation or soil conservation, for drinking water supply or village sanitation, or for communication and transport in the countryside. Refugee Relief and Rehabilitation Grants ear marked for developing lands for mainly agricultural or horticultural colonies may be equally utilised to advantage on the scheme, either separately or in co-ordination with other groups of indigenous population as may be locally convenient or expedient. To secure Rs.60 crores from all these heads from three or more States and the Centre does not seem to be intrinsically difficult. Besides being the beginning of the year and of the second Five-Year Plan period it may be even easier to make adjustments.

81. The result could be as striking as it is welcome. It would be no mean achievement to bring within the scope of vibrant life and prosperity nearly 3 million people subjected to chronic and deepening poverty for decades, with no immediate hope of appreciable improvement in their prospects. To do it satisfactorily, and that too within a year, would be an even more striking but intensely worthwhile achievement.

82. It is possible. An opportunity has presented itself right now. So also is a simple and intensely practical approach thereto available. In seizing this opportunity and turning it to good advantage, it may help us to deepen our faith in the even tenor and harmony of the Indian Way of Life, - namely peaceful and co-operative growth, preservation of a healthy balance between City and Village, between Industry and Agriculture, between Handicrafts and Machines, and above all, respect for and maintenance and promotion of the dignity and the worth of the individual.

83. To dedicate ourselves to such a task in the Dawn of our national freedom would be truly ennobling. It would help us to realise and profit by the tremendous strength and potential inherent in the principles of the Panch Sheel applied within the national and social sphere. It could lead to the early evolution in the areas where this work is carried on of the Sarvodaya Samaj as envisaged by Mahatma Gandhi and on its application elsewhere also on an ever widening scale. Hardly could a more gratifying prospect beckon us onward to its attainment with faith, vision, courage, determination and hope

ESTIMATE OF IRRIGATION WELL.

Description	Top Diameter	200 feet
	Depth	50 "
	Bottom Diameter	50 "
	First Slope	2:1(i.e., 2 Horizontal & 1ft. Vertical up to 25ft. depth from the top.
	Second Slope	1:1(i.e.1ft.Horizontal 1 ft. Vertical upto the next 25ft. depth.

Section	Depth in f	Volume of Excavation in Cubic ft.	Rate per % Cft. (Cut & Carried)	Cost in Rupees.
A(1)	5	135,500	Rs 1/-	1,255/-
A(2)	5	108,500	Rs 1/4/-	1,355/-
B(1)	5	84,500	Rs.1/8/-	1,268/-
B(2)	5	63,500	Rs. 2	1,270/-
C	5	45,500	Rs.2/8/-	1,138/-
D	10	61,000	Rs 4/-	2,440/-
E	10	37,000	Rs 5/-	1,850/-
F	5	11,375	Rs.6/-	682/-
Total	50 Ft.	5,46,875 cu.ft.		11,358

Multiply by 1/3 X(22/7) in formula for Cone Volume.

The Cost comes to Rs 11,926/-

Thus the Cost of the Irrigation Well is Rs 12,000/- average.

N.B.

If the well has to be deepened further by another 10 ft. to reach a total depth of 60 ft. below ground level for increase of flow, this can be done by maintaining the slope of 1:1. The extra cost would amount to another Rs 1,000/-

Area for excavation :- (22/7) X 100x100 Sq.ft = One acre approx.

Area inclusive of Banks (22/7) X 180 x 180 Sq.ft = Two acres approx:

84. Great strides have been made by India since Independence, under wise and farsighted leadership, both at home and in the international spheres. National Income has been well on the upward swing rising from Rs 10,200 crores in 1950-51 to Rs-10,800 crores in 1955-56 and is expected to go up further to Rs 13,200 crores in 1960-61. Between now and 1960-61 the increase in national income will be Rs 2,900 crores.

85. Rapid technological progress is evident all over the world. We are in the era of the atom, whose application for peaceful purposes opens up a vista of unparalleled material advancement. Our resources are bound to grow and multiply, in common with the rest of the world.

86. The Summary of the Plan Frame papers issued under the Second Five Year Plan shows that Rs 8,800 crores are the budgeted expenditure on all accounts, both on the Plan and outside the Plan, by Central and State Governments, for the five year period 1956-57 to 1960-61 covered by the Second Five Year Plan. The expenditure of Rs 60 crores therefrom in some of the poorest parts of the country is likely to produce an extra wealth of Rs 80 crores in each year from 1956-57 for nearly 3 million people inhabiting those areas. For Community Projects the Second

Five Year Plan has allocated Rs 200 crores for the plan period. This works out to about Rs 5/- to Rs 6/- per capita for community improvement over a five year period or Rs 1/- p.a. per capita. Against this, in the areas taken up for improvement with the capital expenditure of Rs 60, crores on Irrigation Wells, the increased income of Rs 80 crores would even if a tenth thereof be set apart for Community Improvementenable 8 crores of rupees to be utilised for benefiting 3 million people. The per capita investment on community development by the people themselves from their own increased resources could easily be about Rs 27/- p.a per capita. The scope for community advancement can well be imagined.

87. It was Gandhiji's dearest wish that the meaning and content of freedom should/translated into the life of the poorest of the land. Swaraj and Ram Rajya were the words dearest to his lips. To the last day of his consecrated life he moved about the country seeking gently and affectionately to wipe the tears from sorrowing faces.

88. The message of Compassion, Goodwill and Love has been enshrined in the hoary history of our Motherland from time immemorial. This year the world is paying homage along with us to the sacred memory of Lord Buddha who hallowed this land with his sacred presence. Great Saints and Seers like Shri Krishna Chaitanya Dev and Bhagwan Shri Ram Krishna Paramahansa Dev have shown the path to human fellowship and brotherliness.

89. We could not better show our deep regard for the principles which they enshrined in their lives and teachings than by translating their message into the lives of millions of our poorest brothers and sisters in a tangible way. On this, the Two Thousand Five Hundred Anniversary of the Advent of Lord Buddha, to bring solace and relief to them as a part of a great national and co-ordinated effort in this direction could well be a Historic memorial benefiting the occasion, and in keeping with the deepest and most cherished traditions of India.

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SUPPLEMENTARY NOTE DATED 2.6. 1956.

Optimum size irrigation tubewells cost Rs. 40,000 each, and give a flow of 33,000 gallons per hour, approximately 1½ cusec flow. (vide. economic of tube-wells - Planning Commission note).

2. The life of these tubewells ranges from 15 to 18 years, as per reports from U.P. and Bihar available to the Planning Commission. The life of a diesel pump is about 10 years approximately.

3. Assuming 4,000 working hours per annum the running cost on a diesel pump of 33,000 gallons per hour capacity is rated at Rs.9,030. (vide 'economics of tubewells').

4. With hydel power supply the cost is Rs.3,000 per 4,000 working hours. With power from medium sized steam stations the cost increases to Rs.4,500 per 4,000 working hours ('economics of tubewells').

5. The note on 'economics of tubewells' prepared by the Planning Commission apparently relates to supply of water at the pump head. Cost of pipes, drains etc. are not separately shown. These may add to the capital or running cost. The same would apply more or less to open large irrigation wells proposed in the notes on large irrigation wells.

6. The Geological Survey Report of 1954 on the ground water resources of West Bengal shows that dug wells about 40 ft. average depth, furnish:

a. 800 gallons per hour in a four ft. diameter well.

b. 4,000 gallons per hour in a 10 ft. diameter well, at digri in Midnapore district of West Bengal.

Similar conditions prevailed in the adjoining districts of Birbhum, Bankura, Burdwan and Midnapore. In other parts of West Bengal the rate of flow is even higher, and the water available at easier depths. Near Calcutta, water is almost available at ground level.

7. In terms of the Geological Survey Report a well having 40 to 50 feet bottom diameter and an average depth of 50 ft., may reasonably be expected to give 40,000 to 50,000 gallons of water per hour flow, or about 2 cusecs flow.

8. Open irrigation wells near Delhi and Muradnagar are within 8 ft. diameter and about 40 ft. deep, and have water about 15 to 20 ft. high. Persian wheels having 50 buckets or canisters, 6" x 6" x 8". One complete revolution is made every 30 seconds. Each canister carries 1 gallon water approximately. In 1 hour about 6,000 gallons is drawn. This also bears out the Geological Survey figures of increased flow with larger diameter, and indicates satisfactory ground water resources. These open wells are found even within 50 to 100 yards of each other and are worked for 12 to 14 hours daily.

Crop Requirements for Irrigation.

9. The 'economics of tubewells' does not mention the irrigation requirements of a paddy crop. It shows 12" requirement for 'other Kharifs'.

10. For Aman paddy the Kansavati Reservoir Scheme for the Bankura, Midnapore, and Hooghly districts of West Bengal shows that irrigation requirement is about 10".

11. D.V.C. reports shows that for winter crops 10 to 12" irrigation is allowed.

12. The 'Bengarl Weekly' of March, 1956 by Shri B.N. Banerji on the 'tubewell irrigation in West Bengal' showsthat 12" water is required for the irrigation of Aus paddy, in the April to May season, the requirement going upto 20" in very unfavourable years.

13. In minor irrigation schemes of the excavation type like tank schemes usually all that is provided for is one Irrigation for paddy in the critical season of October, giving about 3" irrigation.

14. In the bumper paddy year of 1953-54 the Kansabati reservoir scheme shows that about 40" of rainfall occured in the paddy season, July to October. Therefore, 40" was sufficient for a bumper crop of paddy in West Bengal. Rainfall hardly ever falls below 30" in the paddy period in West Bengal. So, 10 to 12" is a fair irrigation requirement for paddy. It is much the same as the "other kharifs" requirement of 12" irrigation in Western U.P., Punjab and Bihar, shown in the note on 'Economics of tubewells'

Irrigable Area.

15. An open large irrigation well 40' to 50' bottom diameter, and about 50' deep, may be reasonably expected to give as much irrigation, if not slightly more than an optimum size tubewell giving 33,000 gallons per hour. The open well may give about 40,000 to 50,000 gallons per hour. There is besides a limited reserve in the open cone.

16. The note on 'Economics of tubewells' perpared by the Planning Commission shows that such a tubewell is scheduled to irrigate 420 acres in all, (Western U.P.).

17. This area is split up in the note prepared by the Planning Commission as follows:-

Rabi	240 acres.
Sugarcane	120 acres
Other Kharif	60 acres
Total :	420 acres

Same pattern for Punjab.

18. The above irrigation is provided at the pump head (tubewell). The note declares that tubewell projects in Bihar State will not be self-supporting. The conditions in that State not being suitable. It also indicates that irrigation from tubewell using diesel pumps may be comparatively too costly to be practicable.

19. As the open large irrigation well (40 to 50' bottom diameter) has a flow not less than an optimum size tubewell of 1½ cusecs. We may reasonably assume a total irrigated area of 420 acres for an open well as for a tubewell.

Relative cost of irrigation.

(By note on 'Economics on Tubewell - Planning Commission)

Crop	Canal Irrigation		Tubewell Irrigation (proposed by the States)		Economical Tubewell rate Planning Comm.	Irrigation inches
			*	**	***	
	U.P.	Punjab	U.P.	Punjab		
Rabi	12/-	6/8/-	12/-	19/-	12/-	9
Other Kharif.	8/-	6/-	16/-	25/-	16/-	12
Sugarcane	32/-	16/8/-	48/-	50/-	34/-	25

N.B.

* The rate is calculated at 16,600 gallons per rupee for non-sugar-cane area, and 11,600 gallons per rupee for sugar cane area, which is the rate proposed by the State.

** The rate is calculated at 10,600 gallons per rupee as per proposal from Punjab.

*** The rate is calculated at 16,600 gallons per rupee as per economical rate proposed by the Planning Commission in its note.

20. A persian wheel irrigates about an acre (slightly less) in 12 to 14 hours with about 72,000 gallons of water. 2 pairs of bullocks or a camel and a pair of bullocks are used by turns. Their hiring charge is about Rs.6/- per day, with two drivers costing Rs.4/- to Rs.6/- in all. This works out to Rs.4/- per acre inch of irrigation.

21. Taking the figures of Rs.3,000 for large scheme or hydel power, Rs.4,500 for small steam power, and Rs.9,000 for diesel power as per note on 'Economics of Tubewells' the following rates for irrigation would appear to apply. There is no depreciation in an open irrigation well as far as repair or longuvity goes. Depreciation on the pump or motor has not been included. 4,000 hours per annum are assumed as in a tubewell. The following rates are comparative:

Crop	Irrigation Inches	Cost of Rs.3,000/- (Hydel)	At 4,500/- Small streams	At 9,000/- (diesel)	* P.W.
Rabi	9"	Rs.4/8/-	Rs.6/12/-	Rs.13/8/-	Rs.36/-
Other Kharif	12"	6/-	9/-	18/-	48/-
Sugarcane	25"	12/8/-	18/12/-	37/8/-	100/-

* Persian Wheel.

N.B.

It will be seen from para 19 and para 21 that the rates for irrigation from open large irrigation wells are the lowest. Even with a diesel pump attached to the open well the rates are lower than those obtaining under hydel power from tubewells in Punjab. Allowances for depreciation of pump etc. is an open well would not appreciably raise the rates to cheaper than Persian Wheel or tubewell irrigation, what pays in either should pay better in open large wells. It also saves labour as well as bullocks for better utilisation in the fields instead of on irrigation in respect of Persian Wheel.

ything un-
nomical.
ce open well.
irrigation

The value of increased yield.

22. An open well yielding 40,000 gallons per hour and irrigating an area of 420 acres, may be expected to give a total increased output of foodgrains by 84 tons per annum, taking 0.2 tons foodgrains as the increased yield per acre through irrigation (Planning Commission's figures). Taking Rs.400/- per ton as the price of foodgrains the value of the annual increased yield is Rs.33,600 per open well.

23. The cost of well is 12,000 rupees. A large size pump costs about Rs.8,000 to 12,000. Add 1,000 rupee for over head. Total cost Rs.25,000/-. Allow running cost Rs.9,000. Total Rs.34,000 which is almost equal to the value of the increased yield in the year.

24. Assuming even a lower figure of 1/7th ton of food-grain as the increase per acre, and taking the cost at Rs.350/- per ton over an area of 240 acres of Rabi and 60 acres of Kharif. We get 300x1/7x350=15,000/-.

25. In addition, over 120, acres of sugarcane allowing an increase of 180 maunds of sugarcane through irrigation and taking Rs.1/4/- per maund as the price we get 120x180x4 and 5/4 rupees =27,000/-.

26. On this basis, the total increased income is Rs.42,000 annual. There is a surplus of Rs.8,000/- over Rs.34,000/- shown in para 23. We may, therefore, expect a full repayment of the cost of well and diesel pump within the first year itself, leaving Rs.8,000 extra for the cultivators. Chain-reaction is, therefore, perfectly practicable.

27. It should therefore, be clear that open large irrigation wells of 50 ft. bottom diameter and an average depth of 50 ft. are

Technically sound and feasible (vide, Geological Survey of India report on ground water resources, West Bengal and irrigation wells in numerous parts of India).

Financially low in cost and easy on speedy recovery of capital investment.

c. Economically paying in increase of crop and general agricultural productivity and quick in return.

, Agriculturally attractive, being close at hand to villages and under their full control.

e. Effective in increasing foodgrains and other agricultural produce substantially, and from within the very first year of the investment.

f. Maintenance and progressive enlarging of production in subsequent years by self-generated finance.

28. The 'Eastern Economist' in its special article headed 'A chain reaction in Agriculture' at page 701 of its issue of 18th of May 1956 points to the soundness of the present scheme of large irrigation wells, and its high potential. Viewing increased output as well as investment subsequently in development with severe caution and level headedness for which the Journal is reputed, it considers that the scheme has a 'investment to income development ratio far below that of any other project in the Second Five Year Plan'. This means that for a given quantum of investment the output or income is the highest of all projects in the Second Five Year Plan.

Proposal

29. To get any tangible results as early as possible and resolve whatever doubts there may be about the reasonable assumptions on cost, increased output, water resources, and general acceptability and attractiveness of the scheme in various States of India, it is suggested that we start with about 12,000 large irrigation wells (open type) within 1956-57. This will help the Kharif at least partly, and the Rabi more fully within this year itself.

30. The cost will be approximately Rs.12,000x25,000 at Rs.25,000 per well including a pump (diesel) costing Rs.12,000/- approximately, and yielding 33,000 gallons per hour. The total cost for 12,000 wells with pumps will be Rs.30 crores approximately.

31. The increased yield taking 0.2 ton per acre for 420 acres irrigated per well will come to Rs.10,80,000 tons, or nearly 1 million tons, a year. The value of the increase at Rs.350 per ton would in 1956-57 be Rs.35 crores. Where food and cash crops like sugarcane or cotton or jute are considered the increased value of agricultural produce from 12,000 wells at Rs.42,000 per well could be conceivably Rs.50,40,00,000 or approximately Rs.50 crores.

32. There should be substantial savings over foreign exchange through this increased internal production. There will also be savings on subsidies for foodgrains. Minor Irrigation schemes could be usefully routed in the direction of excavating these wells as the most profitable means of investment in areas suited to them. Aid from other sources meant to assist the earliest possible increase of production in agriculture may be given.

33. It should be possible in that case that we can assess the results in the light of the assumptions made on as reasonable a basis as exists at present. This assessment will be a recurring and continuing process, as new wells are completed.

34. Even if the flow in wells varies, some being above and some being below 1½ cusecs, the tank portion and the flow may furnish irrigation in areas having a fair rainfall, say 30" or upwards, though the area irrigated may be proportionately less than in the case of a full supply. Such wells in any case serve as a standby irrigation source, superior to shallow tanks, to supplement canal irrigation at critical times as happens for example, in Tanjore, U.P., Punjab, etc. When there is an acute demand from extensive areas for canal irrigation all within an extremely limited period of time. Water harvesting methods may also help in saving of water in the irrigation well, and increase the area for irrigation correspondingly, and hence increased value of total extra annual production, and allow for variation and crop pattern, leguminus and green manure cropping and the growth of fodder as additional aids to the cultivator.

35. That conditions are favourable for ground water resources upto 2 cusecs per well can be inferred, from the performance of open irrigation wells in West Bengal, U.P., and other States. The Geological Survey report regarding dug well in West Bengal gives ample hope. There are some wells of 20" 20 ft. diameter in air fields in Midnapore and Bankura districts of West Bengal, Orissa and other Places. These could be pumped out straightaway for a test of flow, if further assurance is needed. Similarly new wells as they are sunk will provide further test.

36. Large irrigation wells of the type contemplated in this scheme under discussion were partially excavated in 1955-56, in Bankura district of West Bengal and numbered about 55. Of these, some wells reached depths of 15 ft. to 30 ft. from ground level when Test Relief works undertaken as famine/relief measures closed with the advent of the rainy season to be renewed later from September onwards. Even such partially excavated wells, irrigated lands with 12,000 gallon per hour pump working for 4 or 5 hours daily, with no appreciable fall in the water level which was close to the ground being mid and late monsoon period. These wells recouped themselves overnight. The prospects of good flows were uniformally promising in all these cases. About 125 wells for which offers of land were made in 1955 in Bankura district could be completed within a month if orders were given and the rates of flow in all these could provide further proof is necessary or required.

37. The formula for ground water percolation in sub-soils when applied to a 55 ft. bottom diameter well gives about 40,000 to 50,000 gallons per hour flow, in conditions pertaining to the western districts of West Bengal. As defined in Geological Survey Report.

38. These Western districts of West Bengal are the more eroded and arid parts of the State. The report of the Geological Survey shows that even better supplies of water exist in other districts of West Bengal. The figure of 4,000 gallons per hour for a ten feet diameter well in Midnapor district of West Bengal is slightly less than the approximate figure of 6,000 gallons per hour flow in wells 8 ft. diameter near Muradnagar close to Delhi. It is, therefore, reasonable to assume that large open irrigation wells are an intensely practical and profitable means of agricultural development in several States of India in the quickest possible time-utilising our large rural man-power to good purposes for rapid prosperity.

सत्यमेव जयते

APPENDIX III

NOTE. ON THE SCHEME, DATED 30TH APRIL, 1960.

The Pilot Well at Sultanpur, Delhi, was sanctioned in June 1958 by the Ministry of Food & Agriculture, Government of India. Subsequently in December 1958 a Technical Committee representing experts drawn from 3 departments in the Government of India after mature consideration of data so far, then arrived at conclusions on final recommendations which inter-alia declared that :-

Large Kutcha Irrigation Wells of the type of envisaged by Shri Iyengar may not be expected to give a discharge more than 1500 to 2000 gallons per hour even in favourable strata. All experimental observations carried out so far lead to this conclusion. Moreover the conclusion is amply supported by the proved physical facts of the hydraulics of flow in wells.........'

'The calculations and expectations for a high discharge from these types of wells seem to be based on a popular falacious idea that discharges in a well will increase proportionately to the dimensions of the well'.

'In view of the discharge expectations as discussed above, the benefits derived from such wells is not likely to be commensurate with the cost of these wells.

Besides these there are other inherent disadvantages of this scheme, such as occupation of large area of land and constructional difficulties of wet earth excavation which are considered to further and to the infeasibility of this scheme.'

The pilot well is meant to test the feasibility of constructing large kutcha irrigation wells of this type and the economy thereof.

Construction has been ably handled by local talent with the help of timely financial advances from the Indian Cooperative Union's Rural Development Division at Mehrauli, which is being reimbursed with recoveries on running bills paid to the Chairman, Village Development Council, Sultanpur.

The construction of the pilot well is itself proof of the feasibility of constructing wells of this type. Ordinary masonry wells which are the only existing sources of irrigation in the vicinity - caused rupees 5,000 or more and provide inadequate irrigation to hardly 5 acres annually, the pilot well is even now capable of fully and satisfactorily irrigating 200 acres of crops annually. Even on the present figures, capital cost per acre irrigable works out to Rs.200 for the pilot well as against Rs.1000/- for an ordinary well in the same locality. The balance in favour of the pilot well could be even more striking with further deepening. During the progress of construction adequate irrigation was provided to a limited area. The well is being deepended for higher flows. The present flow is not less than 8,000 gallons per hour.

A fishery has been started in the adjacent pond, and the waste land adjoining the well is being developed as a nursery and orchard.

Irrigation has yielded bumper crops. A number of farmers with scattered holdings have benefited by cooperative use of the irrigation water.

The well is proving satisfying and attractive to neighbouring villagers also, who are appreciative of its special advantages and economy in respect of their rapid agricultural development.

P.T.O.

The scheme of large kutcha irrigation wells is designed to utilise rural manpower resources on an extensive scale in securing the speedy construction of similar wells in various parts of the country. It is a labour-intensive public works programme, triggering a chain reaction of accelerated and dynamic rural and urban prosperity.

By this, there will be not only temporary employment given to large numbers of unemployed and under-employed labour in the country-side, but productive irrigation sources willb be created swiftly. 100men working for about 4 months can normally complete a single well.

Irrigation provides a firm base for fruitful agriculture. More crops means more employment, more and cheaper food, and more all-round progress and prosperity. Individual, social, and natural material economy are all enhanced.

The irrigated produce is about a ton per acre in excess of the unirrigated yields. This is immediately verifiable. 35 acres received irrigation during the winter with water pumped out during excavation. There is enough water in the well to irrigate 100 acres of Robi crops and contribute an extra income of Rs.50,000/- thereby. It can also irrigate with ease 50 acres of early and late summer vegetables. Gross value of the extra output could be not less than Rs.50,000/- in the favourable markets afforded by proximity to Delhi.

There are added irrigation benefits of insurance of 50 acres of Karif crops against inadequate and untimely aid and raisingsoil fertility with green manures. The capital cost of the pilot well at Sultanpur can therefore be more than doubly met by the gross value of the annual additional output of the irrigated acreage.

The Eastern Economist tells of this scheme in its article headed "A chain reaction in agriculture" in its issue of 18.5.56 and showed its exceptionally high economic content in the field of planning. The article is self-explanatory and revealing.

The value of the annual increased agricultural output due to irrigation from the pilot well is likely to be more than double the capital cost of its construction. In the main scheme of large kutcha irrigation wells it was assumed that the value of the gross annual increased output due to irrigation would be slightly more than the capital cost of the well and running costs of pumping. The chain reaction built up on the basis of a very conservative estimate of increased output can be even more hopefully visualised in the light of the excellent prospects revealed by the pilot well at Sultanpur where double the value of the project is realised within a year itself.

With a vigorous and judicious husbanding of proceeds of such development, it should be possible to step up production* as speedily, substantially and economically as desired.

With an initial advance of 100 crores of rupees from Government sources in the first year of construction and no fresh Government financial aid thereafter, it is quite possible to set up a chain reaction starting with 20,000 kutcha irrigation wells giving two million tons extra foodgrains in the first year and ending with 24 million tons above the base year in a five-year period of development, alongside final return to Government of the 100 crores advanced initially.

APPENDIX IV.

PLANNING COMMISSION
(NATURAL RESOURCES DIVISION).

Preliminary comments on Shri Mandal's note on stepping up food Production.

....

Shri Mandal has proposed a scheme for the construction of large open wells and pumping water by means of electricity or by diesel engines for irrigating lands for rice and other cultivation. It is based on limited experience of a well which was constructed in Bankura district some time ago. The main points claimed in favour of this scheme are as follows:-

(1) The well should have a very large size of 50 feet diameter at the bottom increasing in steps to about 200 feet at the ground level with a small protective bund all round.

(2) The total land required for this kind of construction would be about two acres for a well and it is suggested that this land should be donated by the villagers themselves. There is also considerable amount of excavation which is expected to be undertaken mostly by the cooperative effort of the beneficiaries.

(3) A well of this size is assumed to give 1½ cusecs flow (or 33,000 gallons per hour) which is the same as a regular 1½ ft. dia. tubewell.

(4) The total working expenses, which mainly arise from the cost of power or fuel oil for running the engine and pump, will have to be borne by the people in addition to a contribution towards the initial cost of the well and the pump set.

(5) The extra yield per acre from a well of this kind was assumed as one ton of foodgrains per acre. As a result of subsequent discussion with the officers of the Planning Commission Shri Mandal has agreed to take an increase of 0.2 ton per acre, which is the average figure assumed for areas benefitted by tube-wells.

(6) It is claimed that if this scheme is launched on a nation-wide scale of 10,000 wells, it would be capable of producing nearly one million tons of additional foodgrains on the assumption that each well would irrigate about 420 acres.

Shri Mandal at first envisaged 40,000 wells each commanding 50 to 60 acres; he has changed this proposal now to 10,000 wells, each commanding 420 acres. There is no clear basis for the assumption regarding the area commanded per well.

(7) The scheme visualises considerable government initiative to the extent that the wells and the pumps are to be installed at government cost and possibly maintained by them or through the village cooperatives.

(8) The extent of additional benefits is expected to be substantially more than the expense of pumping etc. and it is suggested that there would be sufficient savings for reinvestment in constructing more wells so that what is termed a "chain reaction" can develop.

(9) An essential pre-requisite for the successful implementation of this scheme is maximum cooperation from the rural communities for donating the land required for the well and for undertaking to pay back the heavy pumping charges and the initial costs.

2. Officers of the Planning Commission had the opportunity of discussing with Shri Mandal the details of the scheme. Their views on the scheme are given below:-

(1) The satisfactory working of the type of well suggested depends very much upon the soil strength at individual locations and there are doubts as to the performance of such large wells, which may cave in or collapse in course of time. The cost of Rs.15,000/- assumed per well appears to be low and will depend upon the type of soil and the need for any special protective measures.

(2) The extent to which period would be prepared to come forward to donate the land (two acres) and offer to undertake excavations with partial or no wages depends upon the results which may be realised from the first few wells.

(3) The yield of water assumed from a well of this kind appears prima-facie, somewhat high and depends upon sub-soil

water conditions and the proximity to other wells. Such well will, therefore, have to be carefully located at places where there is an assured and plentiful supply of water.

(4) Pumping water from open wells for irrigation purposes is fairly common all over India particularly in places where electricity is available at reasonable cost. So far, individual with initiative and means have availed of it, often with Government loan assistance. The cost of irrigation by this mean is obviously much higher than from flow irrigation. This high cost applies to areas served by tube-wells as in the cost of U.P. or Bihar where water is sold to the cultivators. Past experience has shown that in all cases the people are averse to paying such high rates. The U.P Tubewells Scheme has not been in a position to meet its working costs while in the case of Bihar considerable losses have been incurred on the tubewells scheme. The success of the scheme suggested by Shri Mandal will naturally depend upon the extent to which the cultivator would be prepared to pay comparatively high charges for water provided to him.

(5) There are a great many difficulties in the maintenance of diesel-driven pumps, which is generally expensive. Again, electricity is not widely available.

(6) There are grave doubts as to the ability of a well of the kind proposed to irrigate as alrge an area as 400 acres including some rice cultivation, even for the purpose of supplementing a rainfall of about 25" to 30". This aspect will naturally have to be investigated by State Governments in great detail. Further-more, there may be practical difficulties in distributing the water from a single well over an extensive area of 400 acres which may require long length of pipe or lined channels or hume at high cost which will have to be provided by the landowners or again at government cost.

(7) A nation-wide scheme of 10,000 wells would cost about 50 crores according to Shri Mandal's revised estimates. If local conditions are not so favourable, as he has assumed, the cost would be substantially more.

......4....

(8) The total provision for all the States for the various kinds of minor irrigation works (wells, tanks, tubewells, bunds, canals, etc.) is Rs.78 crores in the Second Five Year Plan. In addition to this, there is a provision of about Rs.50 crores in the Community Development Projects and National Extension Blocks. Before a scheme costing a large sum of about Rs.50 crores, as put forward by Shri Mandal, is considered for implementation, State Governments should be given an opportunity to examine the relative merits of large open well pumping in comparision with other types of minor irrigation works in their States which may be less costly and capable of yielding greater benefits. Even if additional funds were available for minor irrigation works it will still be necessary to determine whether the scheme proposed by Shri Mandal will give better results than other types of minor irrigation works that are undertaken in different parts of the country.

(9) The manner in which the recovery of charges has to be made from a large number of landholders who would be benefited by well irrigation, will have to be carefully worked out. Prima-facie, it is considered that it would be a great achievement if the actual cost of service could be recovered from the cultivators. It is most unlikely that any surplus revenue would result for reinvestment so as to build up a "chain reaction."

(10) The comparative economics and the scale on which a scheme of this kind could be launched depends upon detailed local investigations which will have to be undertaken by the various State Governments, who will also examine the relative priorities and benefits of other minor irrigation schemes which may be capable of producing better results in about the same time.

Sd/-S.Swayambu
5.6.56.

App V - I

No. DSP/PL/SP/I/30
Directorate of Statistics & Planning,
Government of Saurashtra,
Rajkot.

Dated, 26th September 1956.

To

The Secretary,
Planning Commission,
Government of India,
New Delhi.

Subject:- Dr. Pashupathi Mandal's note on stepping up food production.

....

Sir,

I am directed to refer to your letter No.PC(V)/1 (3)(45)/56 dated the 9th July 1956 and to state that this Government agrees with the views expressed by the Planning Commission (Natural Resources Division) in their preliminary comments on Shri Mandal's note.

The assumptions made by Shri Mandal ill not hold in context of conditions obtaining in Saurashtra and the execution of any scheme on the lines indicated by Shri Mandal, is not likely to prove fruitful. Wells sunk in Saurashtra have to be dug through hard stratum, and the costs are consequently high. Again, because of low sub-soil water resources, increase in dimensions of a well will not add proportionately to the watering capacity.

Yours faithfully,

Sd/-(
Director of Statistics and Planning.

सत्यमेव जयते

App V-II

No.3417/XXXV-B-887/56

From

Sri D.B.Dutt, I.A.S.,
Deputy Secretary to the Govt. of U.P.,

To

The Secretary, Planning Commission,
Government of India,
New Delhi

Dated Lucknow, October 4, 1956.

Subject:- Dr. P.Mandal's notes about pumped-Irrigation from large open wells for increasing agricultural production.

Sir,

With reference to your letter No.PC(V)/1(3)(45)/56 dated July 9, 1956, I am directed to say that the scheme prepared by Dr. P.Mandal on Pumped irrigation from open wells appears to be basically unsound. The basic factor that has been ignored in the scheme is that the supply of water from a well (tubewell, masonry well or this type of well) does not depend on the diameter of the well but on the discharge of the springs or water bearing strata that supply water. A larger diameter has only three functions viz. (i) to enable the tapping of all the springs (ii) bigger area for storage and (iii) greater facility or unnvenience for lift arrangement. The third does not affect the supply of water. The second affects it very little. The first is important but is irrelevant to the present case because the maximum size needed for proper tapping of the springs in a particular region is not more than few feet. Thus the basic assumption does not meet the condition of U.P. and the entire super-structure of the scheme based on it does not seem to apply to the needs of this State. Besides this, the large sized wells for storage have an advantage in only those cases where water is lifted by some low-capacity lift such as Persian Wheels etc. They are, however, out of question where a pumping set is used because the entire quantity stored during the night time will be lifted within a few minutes and the well will not work unless the rate of recuperation directly from the water springs is at least as much as the capacity of the water lift. The additional yield of one ton per acre assured under this scheme appears on the high side as the Planning Commission's estimate for additional yield on account of minor irrigation scheme is only 0.2 tons per acre. The estimated cost of Rs.15,000 per well also appears to be gross under-estimate for conditions as prevailing in U.P.

2. The State Government have given very careful thought to the proposals contained in the note and feel that though the scheme might have been a great success in West Bengal, the conditions in U.P. are therefore not very agreeable for taking up the scheme.

Yours faithfully,

Sd/-(D.B.Dutt)
Deputy Secretary.

सत्यमेव जयते

App V - III

GOVERNMENT OF TRAVANCORE-COCHIN

PLANNING DEPARTMENT

NO: L.Dis.24406/56/CS. Dated, Trivandrum, 8-10-1956.

From

The Additional Planning Commissioner and
Secretary, Trivandrum.

To

The Secretary,
Planning Commission,
New Delhi

Subject:- Irrigation- Pumped irrigation from large open wells Scheme of Dr. P.Mandal M.P.,

Ref:- Your letter No.PC(V)/1(3)(45)/56 dated July 9, 1956.

Sir,

I am directed to invite a reference to your letter cited ~~forwarding~~ two notes of Dr.P.Mandal M.P., from West Bengal, about a scheme for pumped- irrigation from large open wells. The scheme of Dr. Mandal has been examined by this Government and they have come to the conclusion that it is neither feasible nor economical/ are summarised below:-

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ate. The
in considera-
ons in the
tter

(i) The scheme of Dr.Mandal is similar to lift irrigation except for the extra cost of wells. In this State, even lift irrigation schemes do not appear to be quite good economically.

(ii) It is extremely doubtful whether co-operation from the public as expected by Dr.Mandal, viz. donation of 2 acres of land for well, free earthwork etc. will be forthcoming.

(iii) Open wells without masonry may not be feasible.

(iv) The cost of wells estimated by Dr. Mandal is too low.
and

(v) Availability of sufficient quantity of sub-soil water is also doubtful.

Yours faithfully,

Sd/-(
For Additional Planning Commissioner and
Secretary.

सत्यमेव जयते

App V - IV

GOVERNMENT OF ASSAM
PLANNING AND DEVELOPMENT DEPARTMENT

NO.PWR.175/56/49 Dated Shillong, the 12th December, 1956.

From

Shri D.R.Kohli, I.C.S.,
Secretary to the Govt. of Assam,

To

The Secretary to the Govt. of India,
Planning Commission, New Delhi.

Subject:- Pumped irrigation from large open wells, as an economical means of icreasing agricultural production.

....

Sir,

In acknowledging herewith the receipt of your letter No.PC(V)/1(3)(45)/56, dated the 9th July, 1956 forwarding therewith two notes prepared by Dr. P.Mandal M.P. from West Bengal on the above subject, I am directed to forward herewith a copy of letter No.3847 dated the [illegible]th November, 1956 from the Agricultural Engineer, Assam, to which the State Government have no other comments to make.

Yours faithfully,

Sd/-(
for Secretary to the Govt. of Assam
Planning and Development Department.

सत्यमेव जयते

Copy of letter No.3847 dated the 9.11.56 from the Agricultural Engineer, Assam, Gauhati to the Additional Director of Agriculture, Assam, Shillong.

Sub:- Notes prepared by Dr.P.Mandal M.P. of West Bengal on Pumped Irrigation from large open wells.

Ref:- Memo No.PC(V)/1(3)/45/56/Govt. of India Planning Commission dated 9.7.56.

In returning herewith the above notes after studying the same thoroughly I beg to state as follows:-

1. The scheme as drawn up by Dr.Mandal M.P. is meant to provide irrigation by pumping out water from open wells excavated to the size of 89 ft. dia at the top and 40' to 50' dia at the bottom and to a depth of 50' ft.

2. The land required for excavation of this large well will require approximately 2 acres of land which should be donated by villagers by themselves. The excavation is also expected to be undertaken mostly by the Co-operative effort of the beneficiaries.

3. The scheme envisages that the Government should bear all cost of installation of the pumping sets and a part of the cost of excavation of well.

4. The prerequesites for the successful implementation of this scheme as pointed out by the Planning Commission is maximum Co-operation from the rural Communities for donating the land required for the well and for undertaking to pay back the pumping charges and the initial cost.

5. As regards the possibilities of introducing the scheme in our State I am afraid I am not in a position to comment for the State as a whole as I have no knowledge of the underground water table or of soil strength of all the areas where irrigation is necessary.

As for the areas like Kaki, Fullangani and Subsnkhata where reclamation of vast areas are done by departments and also Sonajuli where lot of reclamation work was done some year back and problem of irrigation is acute, I beg to point out that the possibilities of introducing the scheme in these areas with success is doubtful inspite of the availability of requisite areas of land for excavating wells, for reasons stated below:-

(1) The underground soil structure of some of the above mentioned areas like Sonajuli and Subankhata is loose for layers of boulders and gravels which will make excavation very difficult to a depth of 50' ft. and even if with difficulties well are excavated cavings of the sides in all seasons and mainly in the rainy season will collapse the wells.

(2) The underground water table in these areas are very low e.g. at Sonajuli a well dug to a depth of 30' ft. keeps barely 3 ft. of water during dry season and even during rainy season water is about 4 ft. below ground level.

(3) The pumping sets when installed will have to be powered by Diesel Engines which will be very costly because of low water tables of the wells and therefore the consumers will not be willing to bear the high cost which may prove uneconomical I, therefore beg to submit that I have grave doubt in my mind regarding the success of such a scheme in our State for the aforesaid reasons.

सत्यमेव जयते

No.FYP-I-55/56-3726/DC
Government of Bihar
Office of Development Commissioner

Patna, the 28th December, 1956.

From

Shri B.D. Pande, I.C.S.,
Development Commissioner, Bihar.

To

The Chief (Natural Resources),
Planning Commission, Government of India,
New Delhi.

Sir,

I am directed to refer to your letter No.PC(V)/1(3)(45)/56 dated 9.7.56 forwarding therewith two notes prepared by Dr. P. Mandal, M.P., from West Bengal, on pumped-irrigation from large open wells and to say that the State Government has examined and considered the suggestions made by Dr. Mandal.

The views of the State Government are as follows:-

(a) To extract 30,000 gallons per hour from an open surface well in Santhal Parganas for irrigation purposes, and, in fact, from any of the area with under stratum of granite in South Bihar is problematic. The geological opinion is decidedly against such wells, as the tendency of the fissures in granite is to close, as we go down, and it is only from such fissures that the wells derive their ground water.

(b) The existing wells in Hazaribagh, Palamau, and Ranchi districts and Santhal Parganas fail to give any yield for potable purposes from April onwards to end of June. If this is for potable purposes, it would be much less for irrigation.

(c) The proposal suggested by Dr. Mandal is not feasible for our State; where under-stratum is favour-able as in Patna and North Bihar, tubewell is the only satisfactory and economical answer.

Yours faithfully,

Sd/-(
Development Commissioner Bihar.

सत्यमेव जयते

From R.G. No.4

OVERNMENT OF RAJASTHAN.

Planning & Development Department

From

The Additional Chief Secretary,
Government of Rajasthan.

To

The Secretary,
Planning Commission,
Government of India,
New Delhi

No.F.3(159)Plan/A/56 Jaipur,

Dated the 19th February, 1957.
20th

Subject:- Pumped- Irrigation from large open wells.

Sir,

I am directed to refer to the Planning Commission letter No.P.C(V)/I(3)(45)/56 dated the 9th July, 1956, and to say that the suggestions made by Dr. Mandal have been considered.

The scheme envisages the construction of open wells having 40 to 50 feet bottom diameter and a depth of about 50 feet. The expected yield from such wells is estimated at 33000 gallons per hour which could be used for irrigating an area of nearly 400 acres of Rabi and Kharif crops. The land for these wells is expected to be released gratis through Bhoodan.

So far as conditions in Rajasthan are concerned it is not possible to have a well of the dimensions as stated in the report or yield comparable therewith.(Obviously i irrigation to the extent envisaged by Dr. Mandal is not possible.)

The cost of lifting water from wells is considerably high and in case any such lift-schemes are worked through State funds, the water rate leviable from the beneficiaries will have to be high if the works are not to be a losing proposition. It is also not advisable to levy such high rates.

In view of the circumstances stated above, the State Government do not think it worthwhile to adopt the scheme in Rajasthan.

Yours faithfully,

Sd/- (
for Additional Chief Secretary.

सत्यमेव जयते

No.FYP-1156(Misc)-R,
Political and Services Department,
Sachivalaya, Bombay,

5th March, 1957

From

Shri B.K.Chougule, I.A.S.,
Under Secretary to the Govt. of Bombay,
Political & Services Department,

To

The Chief (Natural Resources),
Planning Commission,
Government of India,
New Delhi

Subject:- Two notes prepared by Dr. Mandal, M.P.

Sir,

I am directed to refer to your letter No.PC(V)1(3)(45)/56 dated the 9th July, 1956 on the subject noted above and to state that the suggestions given by Dr. P.Mandal, M.P. cannot fruitfully be implemented in this State for the following reasons:-

(i) The suggestions made by Dr. Mandal are not applicable (in this State) considering the geological conditions of the underground stratas and the limited possibilities of getting sufficient sub-soilwater.

(ii)The construction of a successful well in the trap areas of Deccan is even otherwise a gamble and obviously such open large wells in this tract, besides being very costly, are not going to yield 1 or 1½ cusecs discharge.

(iii) In the alluvial tract of North Gujarat, the position of sub soil water supply is better, but besides engineering constructional difficulties in executing such wells, the recuperation of the well is not expected to be of the order of 1 or 1½ cusecs at a depth of 50' or so. Accordingly, even here the scope for such work is limited. It may be added that most of the available deep water resources are being harnessed by the Public Works Department by construction of the tube wells and installation of pumping machinery.

The following observations regarding the cost of open well as recommended by Dr. P.Mandal are also relevant.

The cost of excavation for such well is very much underestimated. The total earthwork for 50' deep well comes to 5.47 lacs cubic feet and the amount thereof is assumed to be Rs.12,000/- i.e. at about Rs.2/- per 100 cubic feet. This is too low a rate. Besides, it does not provide for any dewatering, which may be necessary during excavation in the last 20 feet or so. Taking a flat rate of excavation only at Rs.8/- per 100 cubic feet the cost of excavation only may come to Rs.44,000/- or say 45,000/- including dewatering.

(v) A tube well of 400 ft. depth on an average which may be considered quite safe, as compared to the type of open well in ordinary soils may hardly cost Rs.18,000/- to Rs.20,000/- (including cost of drilling, developing gravel packing and necessary housing, casing, and strainer pipes). A tube well of 16" Diameter under construction under North-Gujerat Tube Wells Scheme gives more or less a discharge of 25,000 to 30,000 Gallons Per Hour as expected from the open well recommended by Shri Mandal.

P.T.O.

No provision for channels required for distribution system appears to have been made.

Assumption of irrigation of 420 acres for a discharge 1½ cusecs appears on high side. This gives a duty of about 100 acres per cusec for all the three seasons. A flat duty of 70 acres per cusec may be the safe assumption. This may give an irrigation of about 300 acres per well.

In view of the above cost of such an open well may come to Rs. 75,000/- details as under

(i)	Excavation etc.	45,000
(ii)	Pump and Engine	12,000
(iii)	Pum house, etc.	4,000
(iv)	Channels including L.A. etc.	14,000
	Total	75,000

Delay in giving a reply is regretted.

Yours faithfully,

Sd/- (
Under Secretary to the Govt. of Bombay
Political & Services Department.

GOVERNMENT OF WEST BENGAL
DEVELOPMENT DEPARTMENT
RAJ BHAVAN, CALCUTTA
DEVELOPMENT BRANCH

No.4900/1S-69/56.

From

Shri H.Banerjee,
Development Commissioner & Ex-Officio
Secretary to the Govt. of West Bengal

To

The Deputy Chief,
Natural Resources,
Planning Commission,
New Delhi.

Dated Calcutta, the 3rd June, 1957.
8th

Subject:- Proposal for pumped irrigation from large open wells for stepping up food production.

Sir,

I am directed to refer to the correspondence resting with the Planning Commission's letter No.NR-1(3)(45)/56 dated the 28th May, 1957 on the above subject and to say that the proposal made by Dr. P.Mandal has been carefully examined by the Irrigation Engineers of this Government. Government have been advised that it would not be economical to provide for irrigation from wells of the type recommended.

Yours faithfully,

Sd/-(
Development Commissioner &
Ex-officio Secretary to the
Government of West Bengal.

सत्यमेव जयते

No.3122-PG-II-57/5666,

From

Shri E.N.Mangatrai, I.C.S.,
Planning & Development Commissioner,
& Secretary to the Govt. of Punjab,
Planning Department.

To

The Deputy Chief (Natural Resources),
Government of India, Planning Commission,
New Delhi.

Dated, Chandigarh, the 10th June, 1957.

Subject:- Dr. P.Mandal's proposal for pumped irrigation from large open wells.

Sir,

I am directed to refer to your letter No.Nr.1(3)(45)/56, dated the 28th May, 1957 on this subject and to state that Dr. Mandal's proposal for pumped irrigation from large open wells has been examined by this State Government in consultation with the State Irrigation and Agriculture Departments and its views are as follows:-

2. The cost of the proposed large-sized open wells is high compared to that of existing wells and flow irrigation and it is very doubtful if the Zamindars would be prepared to accept the scheme on their own initiative. In view of the inability of Government of India, to subsidize the Departmental Tube Well Schemes, it is doubtful if the subsidy as visualized by Dr. Mandal for his scheme, would be forthcoming. There are very few areas in Punjab, where all the requisite conditions for the running of large-sized open wells, as suggested by Dr Mandal are obtainable. It is, therefore, felt that it is not feasible to translate the said suggestion into action in the State of Punjab. Adequate attention, however, is already being paid to the development of Minor Irrigation Works so that a net work of canals should cover practically all areas of the State. Extension of the programme of minor Irrigation Works as decided in the Mussoori conference of State Ministers of Agriculture, is already under consideration of Government of India. In general, the State Government is inclined to agree with the comments of the Planning Commission (Natural Resources' Division) on Dr. Mandal's note.

Yours faithfully,

Sd/-(
Under Secretary Planning,
for Planning & Development Commissioner
and Secretary to Govt. of Punjab,
Planning Department.

सत्यमेव जयते

GOVERNMENT OF ANDHRA PRADESH HYDERABAD
AGRICULTURE DEPARTMENT

Dated the 25th July, 1957.

No.1440 E.II/56

From

Sri M.M.Baig, I.A.S.,
Deputy Secretary to the Government.

To

The Secretary to the Planning Commission,
New Delhi.

Subject:- Irrigation- Pumping through open wells- Suggestions of Dr. Mandal, M.P. and Planning Commission-Report Regarding.

Ref:- From the Govt. of India, Planning Commission, letter No.PC(V)1/(3)45/56 dated 9.7.1956 addressed to Sri S.Narasimham, I.A.S., Development Commissioner to the Government of Andhra, Kurnool.

.....

Sir,

I am directed to invite a reference to the letter cited with which the copies of the two notes prepared by Dr. P.Mandal, M.P. from West Bengal on pumped irrigation for large open wells as an economical means of increasing agricultural production and a copy of the preliminary note prepared in the Planning Commission on the subject were forwarded to the State Governments and they were asked to examine how far the proposals of Dr. Mandal could be adopted having regard to the local conditions and taken them into account while formulating their programmes for minor irrigation works.

2. I am to furnish hereunder the views of the State Governments on the subject.

(i) For undertaking well irrigation, the availability of sub-artesian water withing reasonable depths is the first criterian and it was found that even where canal or river water is available and also electricity at cheap rates, it costs between Rs.12 to 24 per acre to mature a crop and in the case of larger and deeper wells of the kind envisaged by Dr. Mandal, the cost is likely to be higher on account of large lifts. Further the area with reference to which Dr. Mandal had made his observations is the gangetic plain with larger rain fall and small intensities of irrigation and the conditions in Andhra Pradesh except in coastal regions are not comparable as water is scant and deep in other areas. It is, therefore, necessary to investigate each scheme for pumping either from the open wells or bore wells on its own merits and then decide.

(ii) The cost of sinking a well with 200 feet diameter and with 50 feet depth as proposed by Dr, Mandal would cost nearly 53,000 as against the estimated cost of Rs.12,000/- in the note of Dr. Mandal. The geological strata in the Telengana area of this State consists of mostly granite rock and hard morum at lower depth which does not permit proper percolation of water and the recuperative capacity of the wells in this area is also very low. In such a case even if a well of the size recommended by Dr. Mandal is sunk, it may hardly give about 5,000 gallons per hour as against the estimated quantity of 33,000 gallons per hour in Bengal.

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In the Andhra region of this State an ordinary well in non-perenial areas would irrigate about 2.3 acres in a season and in the delta areas where canal irrigation is available, the cultivators sink filter point tube wells and each filter point tube well with pumpset is estimated to cost Rs.3,000/- and it gives a discharge of about 55,000 gallons per hour. A filter point tube well would therefore be more economical than the well size suggested by Dr. Mandal.

(iii) There are a large number of streams in the Andhra Pradesh which carry water till the end of the March. A scheme for carrying out survey and investigation of such water resources and to instal pumpsets on the banks of such rivers and streams wherever possible to get sufficient water for growing crops under lift irrigation is under consideration of the State Government. Such lift irrigation schemes on the banks of rivers and canals are likely to prove more economical than the scheme suggested by Dr. Mandal.

3. In this connection, I am also to state that trial borin have been proposed to be undertaken in 25 places in Andhra are under the explaratory tube well programme which is still under investigation stage for site selection etc.

4. I am, therefore, to state that in the circumstances the State Government consider that the scheme as envisaged by Dr. Mandal cannot be adopted with advantage to this State.

Yours faithfully,

Sd/-
for Deputy Secretary to the Gc

FOOD AND AGRICULTURE DEPARTMENT

LETTER No.34746 FIII2/56.

From

Sri N.Murugesa Mudaliar, B.A.,
Secretary to the Govt. (Incharge).

To

The Secretary,
Planning Commission,
Government of India,
New Delhi.

Fort St. George, Madras, Dated 5-11-1957.

Subject:- Food Production- pumped Irrigation through large diameter open wells- Proposals of Dr. P.Mandal- Remarks- Forwarded.

Ref:- Your letter No.PC(V)/1(3)(45)/56 dated 9.7.56

Sir,

I am directed to invite a reference to the letter cited and to state that this Government have examined the scheme of Dr. Mandal, M.P., in consultation with the Heads of Departments concerned and find that it is unsuitable for this State having regard to local conditions and it connot be preferred to other Minor Irrigation Schemes that included in the Second Five Year Plan of this State such as the Special Minor Irrigation Programme, schemes for de-silting-cum-reclamation of irrigation tanks and sinking of tube wells and filter point wells and river pumping schemes which are generally less costly and more beneficial.

Yours faithfully,

Sd/-(V.H.Balakrishnana)
for Secretary to Government.

सत्यमेव जयते

GOVERNMENT OF MYSORE

No.PD. 1325/58

Mysore Government Secretariat,
Vidhana Soudha,
Dated, Bangalore, 29th April, 1958
9, Vaisakha, 1880

From

The Secretary to the Govt. of Mysore,
Planning and Development Department, Bangalore.

To

The Secretary,
Planning Commission, Govt. of India,
Udyog Bhavan, New Delhi.

Subject:- Dr.P.Mandal's proposal for pumped irrigation from large open wells.

Sir,

With reference to your letter No.2-1/58-Agri. dated the 2nd April, 1958, I am directed to State that the scheme for construction of large open wells for irrigation purposes as an economical means of increasing agricultural production is not adaptable to the conditions obtaining in this State.

2. Lift Irrigation of small area from small sized but steep wells is howe-ver in vogue in some parts of the State where there are reliable ground water possibilities even though the cost of cultivation is stiff and the return not very good

Yours faithfully,

Sd/-(Mani Narayanaswamy)
Deputy Secretary to Government,
Planning & Development Department.

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No.17495/2640/XXII-P-II
Government of Madhya Pradesh
Planning & Development Department

Bhopal, dated the 6 October, 1958
14 Asvina, 1880.

From

Shri B.L.Bijawargi,
Under Secretary to the Govt. of Madhya Pradesh.

To

The Assistant Chief (Agriculture)
Government of India,
Planning Commission,
New Delhi- 2

Subject:- Dr. P.Mandals proposal for pumped irrigation from large open wells.

Sir,

I am directed to refer to your letter No.2-1(21)/58-Agri, dated the 13th May, 1958, on the above subject. The State Government have considered the suggestions made by Dr. Mandal having regard to the local conditions and they are of the opinion that lift irrigation is very costly and pumping sets can be installed only when sufficient water is available. In the open wells here, the water is generally not sufficient for pumping sets.

Yours faithfully,

Sd/-(B.L.Bijawargi)
Under Secretary to the Govt. of
Madhya Pradesh
Planning and Development Department.

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APPENDIX VI.

REPORT OF TECHNICAL COMMITTEE, WHICH EXAMINED THE RESULTS OF TEST OBSERVATIONS MADE IN WEST BENGAL.

We discussed Shri Iyengar's proposal of large-kutcha irrigation wells in three meetings held on 19th, 23rd & 26th December, 1958. We examined in detail the report of the recuperation tests recently performed during the month of November by Shri Jagat Kishore Jain, Assistant Irrigation Adviser on the two large katcha irrigation wells in District Bankura. The discussions on 23rd December had also been attended by Shri Iyengar and we had, therefore, the opportunity of hearing his views in detail. We also examined various earlier reports and letters on the subject including Shri Iyengar's letter of 23rd May, 1957, addressed to the Under Secretary, Ministry of Food & Agriculture and also other references to which attention had been specifically invited by Shri Iyengar. Shri Gorden E. Davis, Senior Hydrologist of the E.T.O. had also attended the discussions on the 19th & 23rd December, 1958.

Our attention had been invited to some observations made by Dr. Mandal, M.P., in his letter addressed to the Irrigation Adviser in connection with the discharge observations of the wells. We have examined these observations and also the recent tour report on District Bankura of Shri Jagat Kishore Jain, Assistant Irrigation Adviser.

After careful examination of the scheme as described above, we have arrived at the following conclusions:-

(i) The large katcha irrigation wells of the type envisaged by Shri Iyengar may not be expected to give a discharge, more than 1,500 to 2,000 gallons even in favourable strata; all experimental observations carried out, so far, lead to this conclusion. Moreover, the conclusion is amply supported by the proved physical facts of hydraulics of flow in wells.

(ii) There are chances that in due course, some silting may take place in the bottom of the wells with the result that recuperation in the well may further reduce.

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(iii) The calculations and expectations for a high discharge from these types of wells seem to be based on a popular fallacious idea that discharge in a well will increase proportionately to the dimensions of the well. This is a positively proved hydraulic fact that increase in flow of a well is only a very small fraction of the increase in the dimensions of the percolation area of the well. It would also follow from the same fact that projection of the results of percolation inten-sities per sq. ft. observed on small wells to large size wells would not be correct.

(iv) In view of the discharge expectations as discussed above, the benefit derived from such wells is not likely to be commensurate with the cost of these wells. Besides, there are other inherent disadvantages of the scheme such as occupation of a large area of land and constructional difficulties of wet excavation which are considered to further add to the infeasibility of the scheme.

(v) As for methods of determining the sub-soil hydrologic conditions and ground water availability of a particular region, we feel that small size borings would be more economical and more revealing of the sub-soil conditions than undertaking the construction of large sized katcha wells entailing heavy order of expenditure.

THE CULTIVATOR'S APPROACH TO IRRIGATION RESOURCE PROBLEM.

Good farming involves getting together the resources needed to carry out farming plans efficiently. Irrigation in dry areas is one of the most important resources, but most cultivators may find that developing irrigation resource is a difficult problem becuase they have to find enough money and credit to have a well or because their holding may not be large enough or in a consolidated block to fit the capacity of the irrigation resource. It is only the most enterprising among them who may muster sufficient courage to invest in a surface well, and that too if their holdings are not too small or too scattered to justify the investment.

On the other hand a larger irrigation source, like a tube well or a large kutcha well, which can irrigate a block of say 100-200 acres, because it looks a bigger resource than an equivalent of a number of small resources, may inspire more courage and confidence in a larger number of cultivators, and they may invest money in developing the resource where they would be shy to do so if it were an individual enterprise.

Therefore the problem of developing irrigation resource when it is a joint rather than an individual enterprise appears less formidable and may occur in the minds of many of the cultivators with greater frequency and force, and begin to appear more practical. In other words, it is a cooperative enterprise which makes it possible for a number of small investors to do more than what a few of the more enterprising among them would be able to do individually.

When we consider that in the case of the Kutcha well one or two pumps would be able to serve a number of cultivators there would be considerable saving to individual cultivators as compared to investing on separate pumps of their own or on Persian wheels with a lot of bullock power, badly needed for intensification of their farming which the new irrigation resource calls for, being diverted to lifting the water.

Thus, where the total of a number of small irrigation resources (say 10 surface well) is as large as one kutcha well, giving equal output of water, at (let us suppose) equal capital investment, opening one large kutcha well may be more economical than number of small wells. Even if it is not, the kutcha well, by creating in the minds of the cultivators the impression that there is such an abundance of water, all available for their use, will help many of them to break themselves away from the old habit of being intent only on trying to do a better job with present resources, and will help them to see the new resource and urge them to exploit it. Theoratically speaking there was nothing that should have prevented them from giving a careful thought to the development of irrigation resource on their own holdings with their own individual enterprise, but the fact remains that farmers the world over, more often than not, give too little attention to resource situation, and it is more likely that they will give attention to it when it appears before them in the bigger form represented by the kutcha well or a tubewell, than when it is confined to a few more enterprising and prosperous farmers.

Then there is the question of water output. The total output from a number of surface wells may be the same as the output from a large kutcha well or a tubewell, yet the areas satisfactorily irrigated in the two cases may be different. A number of weak flows will mean a smaller coverage and

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greater seepage loss than an equivalent amount of a single strong flow.

The cost of any type of well irrigation need not be compared with cost of canal or tubewell irrigation in another part of the country without considering the following questions:

How much of the crop yields are at stake without irrigation?

What are the available irrigation resources and what are the prospects of developing alternative resources?

How much money are the cultivators prepared to pay for getting the possible irrigation resources.

There are many dry areas where growing crops is a greater gamble than in many of the areas where the cultivators indulge in the luxury of complaining of high charges for canal or tubewell irrigation. In such dry areas the cultivators may be prepared to pay irrigation charges which are considered high in the less dry areas, because irrigation in such areas will mean all the difference between success and failure of crop production rather than mean more or less profit from irrigation.

If no alternative sources, like canals or tubewells are present or are likely to become available for several years, and individual surface wells prevent cropping in the off season because of stray cattle, large kutcha wells may serve as a good source to help the cultivators to feel jointly responsible to one another in protecting the crops against stray cattle and thus making possible a fuller use of the irrigation resource developed.

When no alternative sources of irrigation are available the cultivators will be prepared to pay whatever the irrigation will cost them provided they get profitable returns, rather than refuse to utilise the irrigation available only because other farmers in other areas have to spend less on irrigation. Let us not presume; let us leave it to the cultivator to decide whether or not he wants irrigation at the cost at which a particular project works out. Camparison of this cost with what it is elsewhere may not be as important to him as the fact that he needs water for this farming and that he is prepared to pay for it if he finds it profitable.

Sd/- T.R. Mehta.
25.8.60

APPENDIX VIII.

NOTE OF DR. A.K. DUTT ON THE AGRL. ASPECTS OF THE SCHEME.

Factors to be considered for the Proper Evaluation of the Pilot Irrigation Project at Sultanpur, Mehrauli N.E.S.Block, Delhi State, for increased agricultural production.

Irrigation is a means to an end and not an end in itself in increasing agricultural production. In assessing the value of irrigation projects not only the economics of construction but also the concomitant effects of a particular irrigation project on the efficient utilisation of the other tools of production must be equally considered.

It is only against this background that a fair and scientific comparison between small masonry wells and big kutcha wells should be attempted, otherwise our approach to comparison only on the basis of an equivalent number of small wells will lead to erroneous conclusions.

In the context of what has been stated above, I would prefer, from the point of view of increased agricultural production under conditions prevailing at Sultanpur and also under similar conditions in other parts of the country, big kutcha well to an equivalent number of small masonry wells for reasons stated below:-

Big kutcha well at Sultanpur Village:

1. Command with the help of pump a larger area owned by a dozen farmers or more and thus help them utilise fully in the fields their resources of manpower and draught animals which would otherwise be partly looked up in drawing water from individual, small masonry wells, and which would thus reduce the life of draught animals, restrict the farmer's choice to less intensive patterns of farming, and lower the efficiency of the other tools of production such as timely and adequate tillage and interculture operations, etc.

2. Overcome the limitations experienced by farmers having small holdings in securing individual irrigation wells.

3. Create among the farmers voluntary cooperation to their mutual benefit for such operations in the field of production and marketing as -

   i) timely and proper preparation of seed-bed, sowing or transplanting, and interculture by pooling together and balancing individual Surplus and Deficit resources of man power and draught animals, effecting at the same time economy in the use of irrigation water.

   ii) cooperative marketing with larger profits by making farm produce of the different beneficiaries available for a full load for despatch by transport hired either from outside or from among the beneficiaries on the basis of proportionate sharing of transport cost.

4. Promote in the context of points under (1) and (3) Intensive Patterns of Agriculture, enhanced agricultural production and profits, as well as increased employment to the rural population.

5. Make it possible, in the context of point under (3) and (4), for the farmers to own jointly some of the tools of modern and scientific farming, such as improved tillage and interculture implements, spraying and dusting equipment etc., which are so intrinsic to the success of intensive and scientific patterns of agriculture and which cannot otherwise be possessed by individual farmers of small holdings.

P.T.O.

6. Irrigate Diverse But continuous cropping patterns of dozen farmers of more with full utilisation of its total irrigation potential throughout the year.

7. Make it smoother and easier for the agricultural technicians to introduce improved elements of farming for a larger number of farmers within shorter period.

At Sultanpur in one year of Extension Service by the Farm Advisory Unit within the commanded area of the Pilot Irrigation Project much fruitful experience has been acquired in regard to the points mentioned above. The shifting in farming has been from single crops to 2-3 crops (kharif - Rabi-Zaid) in a year, which include vegetables cereals, and fodders, as well as legumes for green manuring. Cooperation among the farmers in regard to the points under (3) and (4) stated above has been developing.

In the case of big kutcha well the prospects of employment of 100-200 rural people for about 4-6 months should not be lost sight off.

The possibility of making bricks from the soil obtainable from the excavation of the well, especially from the depth of first few feet, and utilising those bricks in construction works of rural development sponsored by the Government or by the villagers themselves should be considered. In that case the cost of construction of big kutcha well may be appreciably reduced and the height of the embankment wall may be considerably lowered or completely eliminated.

The raised embankment from excavated soil may be profitably utilised for orchard and nursery with an annual income of about Rs.1000/- to Rs.2000/- per acre from the 5th to the 7th year onwards, depending on the kind of fruit trees grown and management.

Sd/- A.K.Dutt.
Soils & Fertilizers Specialist
Directorate of Extension
Ministry of Food & Agriculture
Krishi Bhavan, New Delhi.

App I

NOTE OF DISSENT

BY

M.A.T. IYENGAR

MEMBER

TO

REPORT OF TECHNICAL COMMITTEE ON LARGE SIZE KUTCHA WELLS SCHEME

NEW DELHI
MARCH '61

CONTENTS

1. Reason for Note of Dissent.
2. Agreement with Dr. A.K.Dutt's Note of Dissent.
3. Operative part of the Report.
4. Scope for application in the country.
5. Removal of misconceptions and misstatements of facts.
6. Tubewells.
7. Basis for execution of the scheme.
8. The executing agency.
9. Anti waterlogging value.
10. Role in scarcity areas.
11. Chain Reaction.
12. Illustration.
13. Development through Government investment of Rs.100 crores.
14. Picture of prosperity.
15. Unanimous recommendation.
16. Application.
17. Appendices I to VII

Note of Dissent to Report of the Technical Committee on Large size kutcha Irrigation Wells.

Reason for Note of Dissent:

1. The redrafted report has been submitted without calling a Committee meeting to consider it first. This has necessitated my present note of Dissent to the report.

Agreement with Dr. A.K.Dutt's note of Dissent.

2. Dr. A.K.Dutt, Soils and Fertilizers Specialist, Department of Agriculture, Government of India, has also submitted on 8.3.1961, his Note of Dissent to the report. His intimate association with extension work at Sultanpur is of special significance. It has enabled close observation of facts pertinent to a scientific and objective assessment of the scheme. I am in agreement with the views expressed by him in his note Dissent, and endorse them.

Operative part of the report:

3. Dr. Dutt's note of Dissent should serve to remove numerous doubts and misconceptions expressed by experts from time to time, and even in the report, about cost and performance of large kutcha wells. The Sultanpur well was undertaken as an experiment designed to find out the validity or otherwise of various opinions advanced in favour of and against the scheme. Results are partly set out in the report, and in view of earlier expressed views against the scheme by some members of the present Committee it is indeed noteworthy that facts are such as to have compelled a change over on their part.

4. The report has kept in view opinions on the scheme by the Planning Commission and the States. The operative part is contained in the final sentence of the report which recommends that construction and operation of large kutcha wells by cultivators cooperatively should be encouraged by Government through financial assistance, technical guidance and extension service.

5. The Committee had as members Technical Experts from Ministries of Irrigation & Power, Community Development and Cooperation and Food & Agriculture. Their joint recommendation of Government encouragement and assistance for the scheme of large kutcha wells shows that its technical and financial soundness can now be considered as conclusively established.

Scope for application in the country:

6. Large kutcha wells can be constructed in any part of the country where small wells function. Small wells are found extensively in every State. The scope for large wells is, therefore, very wide. They have excellent prospects of success in alluvial and lateritic areas, and will do much better than groups of small wells costing together in equivalent sum. They will flourish in all areas where irrigation from small wells is in vogue. In other words the scope for large kutcha wells is as wide as the country itself.

7. The report seeks to restrict severely the application of the scheme (vide pages 29 and 30 of the report). It rules out summarily the bulk of the country from scope of operation of the scheme, and proceeds to add that even in the unspecified isolated pockets where it may be applied it should be considered only when all attempts on sound engineering lines to instal tubewells have failed. This is as much an acknowledgement of

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the fact that large kutcha wells succeed even where tubewells fail, as it reveals the illogicality of recommending priority to a course of action which may fail before undertaking one which will succeed. It is also contrary to geological advice on ground water availability and exploitation through large diameter wells of the open type.

8. Dr. Dutt's note of dissent has closely analysed the economy and merits of large wells relative to small ones and tubewells. He has drawn attention to the fact that various types of irrigation works function in the same area, and that large kutcha wells can and should also usefully figure therein as one of the approved types. This approach is rational.

Removal of misconceptions and misstatements of facts.

9. The report contains several misconceptions and misstatements of facts. But they are pointless in the light of the unanimous recommendation of government encouragement and assistance to the scheme of large wells. Dr. Dutt adequately disposes of most of them in his note of dissent. Such as remain may be dismissed as inconsequential in the light of the final recommendation of the report.

10. It is necessary to mention that during the present Rabi season 80 acres of wheat, gram and vegetables have been irrigated from the Sultanpur well against only 50 acres estimated in the report as rabi irrigation potential. As per accounts kept by the group of farmers at Sultanpur irrigation charges are unlikely to exceed Rs.40/- per acre of wheat irrigation in the whole season, against Rs.100/- assumed in the report. The large kutcha well at Asola village in Mehrauli Block commenced in February last is likely to be completed within April itself. Construction is likely to be over within 3 months, against the suggestion in the report that "normally not less than 3 agricultural seasons, that is, a period of one and a half years will be required".

11. The untenable nature of various misstatements in the report should be apparent from the few instances discussed above, as well as from Dr. Dutt's note of dissent. Most of them are negatived effectively by their inconsistency with the final recommendation in the report itseelf that large kutcha wells merits encouragement by Government financially and otherwise.

12. Discussions in the report about financial prospects of large kutcha wells being executed by individuals or as a Stat enterprise are pointless in view of the fact that the scheme specifically advocated construction and operation on a group basis through loans, and not as an individual or State enterprise.

13. The observation in the report that 'experience on Stat Tubewells and other State Lift Irrigation Schemes indicates that the execution and running of this scheme (of large kutch wells) as a State enterprise may be highly unremunerative' is itself an indirect reminder of the financial imbalance experienced in several types of Lift Irrigation Schemes run as State enterprises, including State Tubewells. The Draft Third Plan sums up the position of State Irrigation Projects generally (vide page 180) and writes that 'irrigation systems are at present working at a loss in almost all States'. Gravit irrigation systems seem to be experiencing financial loss same as State owned schemes of Lift Irrigation.

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14. The Draft Third Plan (pp.180-183) outlines a number of steps designed to improve net receipts from State Irrigation Projects. Speeding up the utilisation of irrigation potential created by projects, upward revision of water rates and introduction of compulsory water cess, and imposition and enforcement of recovery of betterment levy are stressed. The scheme of large irrigation wells, financed through loans to groups of farmers, is free of these complex problems.

Tubewells:

15. The report has made a number of observations about tubewells in the present context which call for some clafication.

16. It should be noted that the Irrigation Adviser, Ministry of Food & Agriculture, submitted in 1958 the Delhi Scheme of Cooperative Tubewells. This has proved stillborn, though the urgency for irrigation was underlined. It was recommended by him for execution on a cooperative basis as he considered that State running would be unremunerative. Not a single tubewell has been executed under this scheme so far. This underlines the important fact that a suitable executing agency and adaptability of a scheme of irrigation to convenient execution and operation by such agency are facters determining progress in implementation.

17. Punjab abandoned in 1959 the further construction of State-owned tubewells included in its Second Plan. It does not seem to be in favour of even cooperative tubewells. Its Third Plan proposes to aid the construction of private tubewells only and on an individual basis. Experience with cooperative tubewells in Uttar Pradesh is also said to be disappointing though those owned by individuals may be working well. Farmers apparently can afford the higher charges for irrigation water used or sold, as in other privately owned lift irrigation,schemes.

18. The note on the Economics of Tubewells by the Planning Commission underlines the imperative necessity of care in the selection of regions for tubewell projects. It further stresses that where cheap power from large hydro or steam stations is not available state tubewell irrigation rates may have to be raised so high as to be impracticable'. Large kutcha wells suffer from no such limitations of cheap power availability, or the special geological conditions necessary for successful tubewell bores.

19. Scope for tubewells is limited as much by considerations of the agencies best suited to execute and run them, as by geological factors and the availability of cheap electricity.

20. A review of the location and working of tubewells in States would offer valuable information on their financial position and irrigation performance. Including cost of power transmission lines a tubewell ranged between Rs.60,000/- to Rs.80,000/- in various State schemes of the Second Plan. In Third Plan schemes of West Bengal they are estimated to cost Rs.80,000/- each, while in Gujarat State the estimate is Rs.1,20,000/-. Upto 1957, annual average acreage irrigated by a Tubewell was below 50 acres in Bihar and Punjab and less than 120 acres in Uttar Pradesh. In Gujarat as per details given in its Third Plan, an average of not more than 100 crop acres a year is expected to be irrigated by a Tubewell within the Second Plan. It will be seen that average Tubewell potential of 400 acres or so is far from adequately utilised.

21. Sultanpur well has in its very first year of completion irrigated about 100 acres already from July, 1960, and is likely to irrigate about 50 acres more by June, 1961. In this region rainfall as well as groundwater conditions are on the low side, and Tubewells here are said to be likely to give a yield about one third of the flow of 33,000 gallons per hour obtained in more favourable zones in the country Large kutcha wells can be trusted to have correspondingly increased flows in such areas too, and their irrigation potential would be much higher than at Sultanpur.

22. In the lateritic zone of West Bengal the Joint Director, Agri. Engineering reported in November, 1956 to the Irrigation Adviser, Ministry of Food & Agriculture, that a team sent by the former found that large kutcha wells in Bankura District were having such heavy in flows that pumping made no impression on the water level in the wells. Dr.P.Mandal, M.P., Bankura, has reported on their continued usefulness even in their incomplete stage. Large kutcha wells therefore have excellent prospects of success in lateritic soils which are described in the report as found in 'large many areas of the country'(vide P.30).

Basis for execution of the scheme:

23. It is to be noted that the scheme of large kutcha wells is a loan-based one. Dr. Dutt has estimated the net annual agricultural return from the Sultanpur Well as capable of being over a lakh of rupees, and even higher. Pre-irrigation returns were hardly ten thousand rupees per annum from the same area. The resultant agricultural benefit which is both quick as well as highly remunerative guarantees satisfactory and full repayment of the loan.

24. There is such wide scope and need for irrigation in all parts of the country that large kutcha wells can usefully find place in the irrigation schemes of every State on a part with other irrigation works. It is well known that Punjab occupies pride of place in Canal Irrigation which has been the mainstay of the economy and development of the State as stated in its Third Plan. It has considerably raised the provisions for minor irrigation works, the bulk of expenditure thereunder being confined to takavi loans for sinking percolation wells and private tubewells and purchase of pump sets. The reasons given for this emphasis on works of this nature in a region so well developed in canal irrigation are reproduced below. They furnish a fuller picture of the value of small works even in the context of larger irrigation projects.

25. Describing these smaller works, Punjab's Third Plan says that "main source of irrigation in the State is by means of canals. But Canal irrigation has got its limitations. There are certain areas where canal irrigation cannot be provided at all due to physical conditions, also canals cannot supply water to entire cultivable commanded area. Sometimes there are long canal closures and crops suffer from drought. There is thus need for supplementing canal irrigation.

26. It then continues, "other means of irrigation should therefore, be exploited for the purpose. These other means consist mostly of exploitation of sub-soil water. Another important advantage of utilising sub-soil water for irrigation would be that it will help avoiding water-logging by keeping the level of sub-soil water down........a part of

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the provision (of takkavi loans for tubewells) will also be utilised for installing State Tubewells of shallow type in aid of and in conjunction with the anti-waterlogging programme.

27. The Third Plan also says that "the irrigation extended during the first two Plans (under the Bhakra multi-purpose Project) is non-perennial because no surplus winter waters are available."

28. Wells therefore have a utility all their own, even in canal areas. They cope with irrigation requirements the year round. This enhances their agricultural value as an irrigation scheme. In areas where surface sources of irrigation are not forthcoming, wells are even more invaluable.

29. The tremendous agricultural potential of Sultanpur large irrigation well has been described by Dr. Dutt. An increase of 100 tons of cereals in two agricultural seasons from a net area of 100 acres is a certainty. A third crop of vegetables or tobacco etc. provides rich returns. All this is within the span of a single year's cropping pattern. Utilisation of potential is as rapid as construction is quick. Returns flow fast. This is a measure of the singular irrigation efficiency of large wells in agricultural development.

30. Dr. Mehta as well as Dr. Dutt had contributed valuable notes for the Committee's consideration, describing the positive advantages which large wells afforded to farmers for improving yields. They not only furnish irrigation in a convenient way, but also what is even more all the year round. They excel in giving water to farmers when they need it, at the right time, the right place, and in the right quantity. They also enable farmers to introduce and apply better and scientific cultivation techniques with confidence. This explains their high agricultural efficiency.

31. Because of all these factors they deserve inclusion in the category of minor irrigation works in the country.

The executing agency:

32. The scheme is designed to be implemented on a loan basis through farmers groups. Groups of farmers may be encouraged to associate themselves in ways convenient to them for construction and running of large wells. This may be a cooperative society. It may be a group of beneficiary farmers jointly taking a takavi loan.

33. This flexibility facilitates freedom of association and joint action, while maintaining requisite control on finance and recovery and repayment of loan. It also provides scope for assistance from different departments in construction and running such wells.

Anti water-logging value.

34. Large wells can figure with advantage both in irrigation and in drainage. Small wells and shallow tube-wells appear in Punjab's Third Plan as irrigation as well as anti-water logging schemes in canal areas.

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Role in Scarcity areas:

35. The Parliamentary Consultative Committee on Food and Agriculture has recommended the sinking of large kutcha wells in agriculturally backward areas where scarcity conditions are endemic, and their inclusion as relief work programme in such regions. It has further recommended encouragement to groups of farmers jointly to undertake construction of such wells and work them and the grant of usual subsidies in addition to loans admissible in minor irrigation works.

36. These recommendations furnish a wide scope for action.

37. There are many scarcity areas in India. The Foodgrains Enquiry Committee appointed by Government of India in 1957 indicates their extensive spread. Uncertain rainfall is a prime source of concern and trouble. Irrigation offers the best remedy in many of these cases, specially when it can serve a group of farmers satisfactorily all the year round and overcome limitations imposed by small or scattered holdings Large irrigation wells suit this purpose admirably. They are easy to construct by unskilled labour and equally amenable to maintenance and operation by groups of farmers themselves. They are ideal relief works in times of distress.

38. Close and enthusiastic participation by villagers in scarcity areas where necessity for irrigation is acute can be expected. Rapid progress can be assured with good administrative assistance. Respondency will give way to cheerful confidence in the context of smiling fields, good and nutritious crops, greater employment and wholesome water. Better health, cattle and housing will follow. The scourge of poverty can be reduced.

Chain Reaction:

39. The report quotes the view of the Planning Commission on Chain Reaction outlined in the scheme and concludes that it sees no prospects of a chain reaction being set up because 'beneficiaries will find it very difficult, to pay even the irrigation charges' for running wells.

40 But their recommendation for cooperative loans for the Scheme shows that members are perfectly satisfied that agricultural returns following irrigation from such wells will be enough to pay not only the irrigation charges, but also such instalments towards repayment of loan as due.

41. The Planning Commission's view appears to have been based primarily on difficulties over recovery of water rates in State irrigation schemes. It noted that people were averse to paying the 'high rates' prevailing in State Lift irrigation schemes, and that the U.P. Tubewells scheme had not been in a position to meet its working costs, while in Bihar considerable losses had been incurred on the Tubewells scheme'. Analogy with State-owned schemes does not hold good in the case of large kutcha wells run directly by farmers. Besides the basis for chain reaction is the net agricultural return the group of farmers derive annually from lands irrigated by large wells. This is very substantial and therefore provides scope for a chain reaction being developed.

42. The Pilot Project at Sultanpur furnishes material for examining the principle of chain reaction in the light of increased net agricultural return. The soundness of the principle would be clear from the discussion below.

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Illustration:

43. Large Irrigation Wells can be completed within 3 months by 200 labourers working together, A group of farmers will be able to construct a well with a loan of Rs.40,000/-. Thereafter villagers can finance construction of further similar wells in the area with their increased incomes from irrigated agricultur They will finally return the original loan with interest after their chain of large irrigation wells is completed - or earlier if so desired.

44. The Sultanpur Experimental Well demonstrates that the increase in annual agricultural income in the irrigation command of the well can be more than double the cost of construction. Over Rs. one lakh increase income is possible in a year against Rs.40,000/- normally required for completing a well. Hence it is possible for farmers benefiting therefrom to earmark Rs.40,000/- from this increased income for constructing another well in their village lands in the next year. This furnishes them with two wells in the second year. They can add more wells from year to year so as to irrigate as much land as the village needs to provide irrigation for 1200 acres may need 12 wells. Progress is pictured as per statement attached.

45. In the 6th year the initial loan of Rs.40,000/- would be paid off with interest as due. 12 wells commanding 1200 acres would have been completed already. Annual foodgrains production could be 1440 tons against 240 tons of the base year. Annual agricultural output from foodgrains, vegetables, oilseeds etc. could value Rs.13,20,000/- against the gross income of Rs.1,20,000/- of the base year. The village could be better off by this extent over the base year in all years following.

Development through Government Investment of Rupees One Hundred. Crores.

46. 25000 large kutcha wells can be completed in as many villages in scarcity areas within a year at a cost of Rs.100 crores. Another 25000 wells can be completed in the Second year, 50,000 in the third, and so on, with reinvestments from the extra agricultural returns afforded by the first and succeeding groups of wells. 300,000 wells can be completed in this way within a five year period.

47. 25,000 wells can help to produce within a year of operation 2.5 million tons of extra foodgrains in scarcity areas provided with perennial irrigation facilities. This extra yield is available year after year with no further capital outlay on the irrigation source. 25,000 wells can themselves eliminate once for all the need for importing and paying for 2.5 million tons of foodgrains at about 100 crores of rupees for each year of continued import. One hundred crores of rupees thus invested in constructing 25,000 large wells in a year can save five hundred crores of rupees to be spent on the import of 12.5 million tons of food grains over a five year period.

48. Foodgrains production can also be stepped up from 2.5 million tons extra in the first year to 30 million tons extra within about 6 years, the number of large wells increasing from 25,000 in the first year to a total of 300,000 wells constructed within a five year period. The Government loan of Rs.100 crores would have set in motion a progressive chain of well construction, financed by the benefited farmers themselves, from the second year onwards. The loan would also be repaid finally to Government, with full interest as due. A government

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investment of Rs.100 crores repaid fully within 6 years with interest, would have fostered a development leading to increased foodgrains production of 30 million tons by the end of five years, apart from other valuable agricultural produce.

49. Multiple cropping, intensive agriculture and scientific farming all tend to foster rural employment as much as they enhance agricultural wealth. Industry, transport and commerce will flourish with agricultural prosperity assuring good markets for the products of industry. There would be considerable investment in productive and developmental enterprises all round with the increased wealth available. This again creates more wealth and employment. Manifold social and economic advantages accrue.

Picture of Prosperity:

50. Dr. Dutt has described the transformation in the pattern and intensiveness of agriculture which farmers of Sultanpur have undertaken with irrigation from the well. He rightly observes that it has to be seen to be believed. It is so striking. The impression on neighbouring farmers is profound.

51. The Public Accounts Committee the Parliamentary Consultative Committee on Food and Agriculture, distinguished visitors and important journals and Newspapers like Indian Finance, Eastern Economist, Time of India, Hindustan Times, Statesman, Indian Express and others have seen it and commented very favourably from time to time.

52. These comments bring out points of special advantage which the scheme of large kutcha well offers in speed of construction and utilisation, economy of public expenditure in its implementation, employment of rural manpower on a large scale both during construction and later in intensive agriculture itself, very rapid rise in agricultural output and rural income relief of scarcity and saving of foreign exchange.

Unanimous recommendation:

53. After close study of the scheme from the technical angle and bearing in mind points urged in favour of and against all Committee members are now unanimous in recommending that the scheme of large kutcha wells should be encouraged by Government through financial assistance, technical guidance and extension service.

This is a recommendation with which Dr. Dutt has also concurred.

I endorse it equally.

Application

54. The scheme deserves wide application.

55. Large wells of this type are a somewhat novel method of utilising available ground water resources for agricultural production.

56. A fresh administrative approach in the revised light presented by the unanimous recommendation of the Technical Committee could bring about wide application of the scheme.

Sd/- M.A.T.IYENGAR
15.3.61

M.A.T.Iyengar,ICS,
96, Constitution House, New Delhi.

FOR 1200 acres in all

ar	Initial Loan	Investment in construction during year	No.of wells constructed during year	Extra Income from wells constructed during year (from food grains, vegetables etc.)	Base year income at Rs.100 per acre	Total extra income over base year	Provision for investment for wells next year	Provision for savings and other investment.	Extra food-grains from wells constructed during year (tons)	Base year food grains production (tons) at 0.2 tons per acre	Total food-grains over Base year (in tons)
	2	3	4	5	6	7	8	9	10	11	12
	Rs.	Rs.		Rs.	Rs.	Rs.	Rs.	Rs.			
se	-	-	-	-	1,20,000	-	-	-	-	240	-
	40,000	-	1	1,00,000	-	1,00,000	40,000	60,000	100	-	100
	-	40,000	1	1,00,000	-	2,00,000	80,000	120,000	100	-	200
	-	80,000	2	2,00,000	-	4,00,000	120,000	280,000	200	-	400
	-	1,20,000	3	3,00,000	-	7,00,000	200,000	500,000	300	-	700
	-	2,00,000	5	5,00,000	-	12,00,000	40,000 (towards repayment of loan	1160,000	500	-	1200
				-						-	1200
	40,000 (repaid)		-	-	-	12,00,000	-	300,000	-	-	1200

सत्यमेव जयते

NOTE OF DISSENT

By

Dr. A. K. Dutt
Soils & Fertilisers Specialist
Farm Advisory Unit
Directorate of Extension
Ministry of Food & Agriculture
(Deptt. of Agriculture)

To

"Report Of The Technical Committee

ON

Large-Sized Kutcha Irrigation Wells"

New Delhi
March , 1961

CONTENTS

Page

1. Introduction 1
2. The pre-irrigation agriculture of Sultanpur 1
3. Recommendations of Geological Survey of India 1
4. Flow from open wells 2
5. The irrigation potential 2
6. Comparative cost of small masonry wells on the basis of the equivalent irrigation potential of the big kucha well of the Sultanpur Project 4
7. Relative cost of excavation in other parts of the country 5
8. The agricultural potential 5
9. Prevalent Irrigation rate at Sultanpur and nearby villages 7
10. Some salient features regarding employment potential, brick making, perennial irrigation etc. 7
11. Land availability for excavation, silting up, erosion hazard, pump shifting etc. 8
12. The structural stability 9
13. The scope of application to other areas of the country 10
14. The executing agency 10

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Introduction

As per terms of reference vide Ministry of Food and Agriculture No.2-1/59 IMW dt. the 12th August, 1960 for the scientific evaluation of the Sultanpur Pilot Irrigation Project, the committee required the relevant vital information on other alternative sources of irrigation in Mehrauli area. The average irrigated areas of small masonry wells at Sultanpur and Chatarpur provided to the committee by the Engineering staff of the Delhi Administration on two occasions were proved to be wrong and ultimately the help of the Revenue Assistant of the Delhi Administration had to be sought for to obtain the correct figures. Thus the committee spent 3 days to obtain information only on one alternative source of irrigation that was masonry well. The various appendices given with the redrafted report had not been discussed at the committee meetings.

In my D.O.No.60/SFS-295, dt. November 28, 1960 and D.O.No.60/SFS-299, dt. November 30, 1960 to the Irrigation Adviser, I had requested him for some very vital information that would enable me to submit my comments on the first drafted report. The information was given at the last meeting and before closing of this meeting it was announced that the date of the next meeting would be communicated to the members.

In the mean time the redrafted report was received by me on December 28, 1960 from the Irrigation Adviser and immediately in my D.O.No.60/SFS-311, dt. December 28, 1960 to him information on the date of the next meeting was requested by me. But no further meeting was held.

In my last above-mentioned D.O. to the Irrigation Adviser I had stated that I had not agreed with many of the points expressed in the redrafted report. I have now prepared my note of dissent on the redrafted report. The more recent information that has become available from the working of the Sultanpur project has also been utilised in the preparation of my dissension note.

The Pre-irrigation Agriculture Of Sultanpur

I have been intimately associated with extension work at Sultanpur village since July, 1959 when the Pilot Irrigation Project of big, open kucha well was under construction. The annual rainfall of Mehrauli is about 18". The crops grown are predominantly rainfed, and only small areas are irrigated by a few masonry wells. The principal kharif crops are jowar and bajra while the rabi crops are barley, gram and mustard. Wheat, vegetables, maize, sugarcane, chari fodder, etc. cannot be grown without supplementing the rainfall with irrigation. In other words, the full benefits from the use of improved agricultural practices covering the aspects of soils, fertilisers and manures, improved seeds, improved implements, etc. can only be realised in these areas with the help of timely and adequate irrigation.

Irrigation, it may be recalled, played the key role in the selection of districts under the Ford Foundation Plan for intensive agricultural development (Package Programme). In fact, intensive agriculture generally requires for its effective development an Irrigation Base.

Recommendations of Geological Survey of India

This area, according to the information available, cannot be commanded by canal or tank irrigation. The only possibility of supplying additional water for crops is the exploitation of the ground water resources.

As far back as 1949, 2 test tube wells were drilled by the Central Ground Water Organisation in Chatarpur Basin near Mehrauli to a depth of 220 ' to 300'. The initial discharge was 12,000 gallons per hour with a depression of the water level by about 62', but the yield of water had gone down to 6,000 to 7,000 gallons per hour within a few months.

According to the findings and recommendations of Mr. D.N. Sett of Geological Survey of India, the geological conditions of Chatarpur basin of Mehrauli might not be suitable for extensive tubewell operations and instead wells of large-diameter ought to be sunk to a minimum depth of 100 ' or so in the area.

According to the findings and recommendations of Shri K.R. Madhwa Simha of Geological Survey of India, tubewells in some areas of the Chatarpur Basin may be expected to give good results, but in the neighbourhood of Ghatorni and Maidangari only large diameter wells will be useful. His recommendation on the depth of boring of tubewells varies from 250-400'.

In view of the uncertainties of obtaining good and sustained flows through tubewells in this area, the Exploratory Tubewell Organisation has advised that in every site proposed for a tubewell, a pilot bore should first be drilled and tested.

Flow From Open Wells 1

The Technical Committee set up in 1958 had remarked that "the large kucha irrigation wells of the type envisaged by Shri Iyengar may not be expected to give a discharge more than 1500 to 2000 gallons even in favourable strata, etc." But known facts about flows from open wells conflict with this statement.

The Geological Survey Report of 1954 on the groundwater resources of West Bengal indicates a discharge of 800 gallons from a dug well of 4 ft. diameter and 4000 gallons from a well of 10 ft. diameter.

The redrafted report on page 22 had indicated for the well of Shri Ram Phal of Sultanpur to have an inflow more than 3,000 gallons per hour during pumping.

The 16 ft. diameter well of Chaudhuri Ramji Lal of Sultanpur, excavated to a depth of about 80 ft., was said to have a flow of 6000-8000 gallons per hour.

The 9-10 ft. diameter well of Shri Mam Chand of Sultanpur, excavated to a depth of about 55 ft., was said to have a flow less than 2000 gallons per hour. in spite of 3 borings having been made.

The measurements made in January, 1960 by the Assistant Engineer Delhi State on the flow of Sultanpur well then under construction are said to have given a flow of 6000 gallons per hour approximately exclusive of the inflow from boring.

These facts are themselves indicative of the deficiencies of the previous Technical Committee's remark about the maximum limit of flows in open wells.

The Irrigation Potential

Every Irrigation project has in it an irrigation potential and an agricultural potential. The economics of an irrigation project is generally determined by its cost, its irrigation potential, its agricultural potential, and its expected gross revenue.

The irrigation potential of the project under consideration with the sustained flow available at different seasons of the year can be fully judged under normal conditions, i.e. conditions which prevail in well-developed irrigated areas, such as level lands, economic use of water, seepage-proof conveyance channels, proper crop rotation etc. The sustained flow of the Project at maximum draw-down head has not been investigated at all by the committee. This seriously detracts from the value of observations and remarks about the yield of the well made in the redrafted report.

The observations of the committee were confined to a part of the monsoon and a part of the growing season of rabi crops. The discharge of the pump according to the officers deputed for the observation varied, going upto even 18,000 gallons per hour or so, as was verbally reported to me by them during my tour to the village. The Sultanpur farmers took up large scale irrigation for the first time last year from this project and the conditions were far from what prevailed in well-developed irrigated areas. According to the opinion expressed on page 20 of the redrafted report the annual irrigation potential of the project is 100 acres.

During the period of test in December, 1960 the pump worked on the average for 8 hours. Had all the farmers been ready for rabi irrigation last year, the pump would have worked for longer period (say, 12 hours a day) and at larger draw-down head. In that case the area that could be irrigated would have substantially increased. During discussion of the committee meeting it had been stated that the water yield of the open well could not be predicted as adequate data about the flow from such wells at different draw-down heads were not available. Hence the estimated yield of 6,000 gallons per hour at 30-35 draw-down head needs confirmation through test. Mr. Iyengar was said to have obtained a much higher flow at that draw-down or so before the beginning of 1960 monsoons.

Under a given set of conditions there will be two standard curves of yield from an open well, one from a depressing head and another from an replenishing head. One very pertinent question had been asked by me to the committee as to relative recuperation rates of a depressing as well as of a replenishing head of an open well for the same range of draw-down heads, say λ_1 to λ_2 and vice versa. The question could not be answered by the committee, though it had a very important bearing on determining scientifically and correctly the irrigation potential of the well.

In the case of either a replenishing or depressing head the inflow from the well is towards establishing the equilibrium of the physical system (the static water head). But the inflow in the case of a depressing head is towards replacement of the product of inflow (water) removed, a process which disturbs the equilibrium of the physical system. Thus according to the laws of dynamics governing the equilibrium of a physical system, the inflow during a falling head will be higher than that during a rising head.

The total yield of water delivered by a pump for a given working period determines the coverage by irrigation and is equal to the storage emptied plus the inflow from the well during the period of depression. Hence it is imperative that the recuperation rate of a falling head shall be used as a measure of the inflow from an open well for scientific assessment of yield. Therefore, the irrigation potential scientifically assessed will be higher than the irrigation potential shown on page 20 of the redrafted report.

Assuming that the recuperation at 30-35 ft. draw-down is 6,000 gallons per hour as shown on page 17 of the redrafted report and the pump works at that particular draw-down, the area of 50 acres for rabi shown on page 20 of the redrafted report will increase to 66 acres.

The wheat crops at Sultanpur required irrigation at an interval of 5-7 weeks this year. This interval is similar to that shown on page 19 of the redrafted report where 6-8 weeks interval is allowed in canal and tubewell irrigation of Uttar Pradesh. Hence the annual irrigation potential of 100 acres shown on page 20 of the redrafted report becomes very much of an underestimate as it is based on an irrigation interval of 30 days only.

Thus the area which can be irrigated by the project according to the interval of 5-7 weeks comes to 82-115 acres, say 80-110 acres.

When the discharge from the pump was 18,000 gallons per hour as had been reported to me by the officers deputed there, it was observed from the records that in the first irrigation some fields required about 7 hours to irrigate an acre. That is, one acre required about 5½ acre-inches. In fact almost all the fields required more than 4 acre-inches this year in the first irrigation. This was unavoidable when a new rain-fed area was brought under cultivation immediately with the completion of the project. The farmers will be able to effect substantial economy in the use of water in subsequent years. Thus with the economic use of water the area will increase substantially. The irrigation potential of the project should be judged not under abnormal conditions but under normal conditions that are generally obtainable in the well-established irrigated areas of the country.

Hence the seasonal irrigation potentials of the project are:-

Rabi (wheat)	:	80-110 acres
Zaid rabi	:	30-40 acres
Kharif	:	80-100 acres
Total	:	190-250 acres

The kharif crops will need only protective irrigation. Thus the annual irrigation potential of the project is 190-250 acres.

A tubewell with a discharge of 33,000 gallons per hour on the basis of 12 hours' working has been estimated to have an annual irrigation potential of about 420 acres as given on page 19 of the redrafted report. The Pilot tubewell irrigation project now contemplated for Chatarpur Basin with a discharge of about 10,000-12,000 gallons per hour on a similar basis of 12 hours' working will have an annual irrigation potential of 140 acres and not 200 acres as shown on page 23 of the redrafted report.

The average life of a tubewell ranges from 15-18 years. As to the life of the open wells Delhi itself can display more than 100-years old open wells which are still being effectively used for irrigation.

Comparative Cost Of Small Masonry Wells On The Basis Of The Equivalent Irrigation Potential Of The Big Kucha Well Of The Sultanpur Project.

The superiority of the big kucha well to a large number of small masonry wells with an equivalent aggregate annual irrigation potential has been fully discussed in the notes submitted to the committee by Dr. T.R.Mehta and myself (vide appendix VII and VIII of the redrafted report). In accordance with the information on the cost of small masonry wells given in appendix VII furnished with the letter No.2-1/59 IRN dt. the 12th August, 1960 of the Ministry of Food & Agriculture an ordinary masonry well at Sultanpur and Chattarpur villages costs on the average Rs 5,000/- and according to the latest information supplied to the committee by the Revenue Assistant of the Delhi Administration about the area irrigated by the 15 wells of Chatarpur during 1958 and 1959 kharif and during 1958-1960 rabi (vide memo No. 921-DIA/60, dt. the 4th November, 1960, issued by the Deputy Irrigation Adviser) the average area irrigated by such a well is not more than 4 acres in a year. Thus the Sultanpur Project is equivalent to:

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(a) 25 small masonry wells with a total cost of Rs 5,000/- x 25 or Rs 1,25, /- as per estimate of the annual irrigation potential of the Sultanpur project shown on page 20 of the redrafted report.

(b) 47 to 62 small masonry wells with a total cost of Rs 2,35,000/- to Rs 3,10,000/- as per my estimate of the annual irrigation potential of the Sultanpur Project.

The cost of the Sultanpur pilot irrigation project including the pumps and irrigation channels is Rs 64,000/- as shown on page 6 of the redrafted report.

Relative Cost Of Excavation In Other Parts Of The Country

Compared to the cost of excavation of the Sultanpur well, what should be the cost of similar wells in other parts of the country? In places where the water table is nearer and the flow is more, the depth of excavation required for good flow will be less. Also where the wages are lower than Rs 2/- per day paid to the labourers of the Sultanpur Project, the cost of the well will certainly be proportionately less and not more as stated on page 7 of the redrafted report.

Had the excavation of the Sultanpur project been restricted to the period excluding the monsoon months and had the supply of materials and resources been made in time, the cost of excavation of the Sultanpur project would have been less.

The Agricultural Potential

As already stated, every irrigation scheme has an irrigation potential and an agricultural potential associated with it. The two together must be evaluated to assess the economic usefulness of any irrigation project. The period by which either of the potentials may be fully developed will depend, among other factors, on the effective extension service on the one hand and on the effective response and co-operation of the farmers, on the other.

In situations where both the factors are favourable, the full development of the agricultural potential may be attained in a relatively short period as indicated by the trend of extension work of Farm Advisory Unit at Sultanpur while the full development of the same potential primarily with farmers' initiative and resources is also possible but may take somewhat longer period as may be seen at the well-developed intensive vegetables and tobacco growing areas of Sahapur Jat, Chirag Delhi and Masjid Moth. But the agricultural potential is an inseparable feature of the project just as the irrigation potential is and hence it must be taken into account for a proper evaluation of the project.

Yardsticks which are employed at present in assessing increases in the outturn of the agricultural produce due to irrigation vary from 1/5th to 1/2 ton enhanced yield per acre. The question arises whether these yardsticks can be equally applied to all parts of the country, including regions of very low rainfall.

Let us take the case of Mehrauli with an annual rainfall of 18". Here some crops like maize grains, vegetables, sugarcane, wheat, tobacco, potatoes, etc., or summer (zaid rabi) vegetables or fodder crops (lobia) cannot be grown at all without irrigation on the upland soils. What increases in agricultural output due to irrigation should be considered? It is obvious that the entire output of such crops under such conditions is the additional production arising from irrigation.

The next question that arises is that with the full development of the agricultural potential what per cent of the total increase in agricultural production is due to irrigation and what per cent of the total is due to improved practices? The very low rainfall of Mehrauli immediately limits not only the range of crops but also the application of improved practices such as increasing use of fertilisers and manures, better crop rotations, etc. Hence irrigation is the primary factor under Mehrauli conditions, while all the other components of improved practices are entirely dependent upon it.

Let us now see what can be the gross acre-value of produce from the development of the agricultural potential with the irrigation of the Sultanpur project. In our demonstrations at Sultanpur with cauliflower, peas, and potatoes, etc. we have found that the gross acre-revenue may be Rs 2,140/- for the early cauliflower, Rs 1,500/- to Rs 2,000/- for early potatoes, and Rs 1,500/- or so for early peas. A reprint of our demonstration on cauliflower is enclosed (appendix I). However, let us take a conservative estimate of the gross revenue per acre for the evaluation of the project, say Rs 1,500/- for vegetables, Rs 600/- for wheat and mustard and maize and fodder crops etc. Thus, according to the annual irrigation potential of 100 acres as shown on page 20 of the redrafted report and my estimate of the irrigation potential of 190-250 acres (say 200 acres), the estimated annual gross revenues are:-

Annual Gross Revenue

		As per annual irrigation potential of the redrafted report	As per my estimate of the annual irrigation potential
1. Rabi	(a) Wheat and mustard	30 acres Rs 18,000	60 acres Rs 36,000
	(b) Vegetables	10 acres * Rs 15,000	20 acres * Rs 30,000
2. Zaidrabi			
	(c) Vegetables	10 acres Rs 15,000	20 acres Rs 30,000
	(d) Fodder crops	10 acres Rs 6,000	20 acres Rs 12,000
3. Kharif	(e) Vegetables	20 acres Rs 30,000	40 acres Rs 60,000
	(f) Fodder crops	10 acres Rs 6,000	20 acres Rs 12,000
	Total	Rs 90,000	Rs 1,80,000

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* When replacing wheat by vegetables, one acre of vegetable has been taken to be equivalent to 2 acres of wheat with regard to water requirement

Thus the annual gross revenues come to Rs 90,000/- and Rs 1,80,000/- for the annual irrigation potential of 100 and 200 acres respectively and far outweigh the total cost of Rs 64,000/- for the project. The annual net revenue will be about 70-80% of the gross values, that is Rs 63,000/- to Rs 72,000/- to Rs 1,26,000/- - Rs 1,44,000/-. It may be stated here that on account of the proximity of the village to the capital the farmers will gradually switch over to more intensive vegetable cultivation as can be seen at Sahapur Jat, Chirag Delhi, and Masjid Moth, and hence both the annual gross and net revenues will register further increase.

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The redrafted report has not touched at all upon the agricultural potential of the project without which the proper evaluation of the project is not possible, and frequent remarks which have been made in the said report about various operational phases of the project being uneconomic, cannot be considered valid.

Prevalent Irrigation Rate at Sultanpur And Nearby Villages:

There is a standing practice at Sultanpur and nearby villages with regard to the sharing of crops between farmers when one farmer receives water from the well of his neighbour. On enquiry from the farmers and the Patwari of Sultanpur, it transpired that the irrigation rate was generally paid in kind and that it amounted to 1/3 of the produce. This point was also confirmed by Mr. R.V.Rai, Sikka, Section Officer of B.D.O. Mehrauli, in the committee meeting held on November 25, 1960.

On my enquiry from the present B.D.O. of Mehrauli it was explained by him that inclusive of all charges such as man and bullocks working on Persian wheels as well as incidental costs, the irrigation rate would be equivalent to 1/3 of the crop produce. This point has not been clearly expressed on page 11 of the redrafted report, though it has a vital significance.

In other words, the irrigation rate in equivalent value of 1/3 of the crop produce will be Rs 150-200 for wheat, Rs 250-300 for sugarcane, potatoes etc., and this value will rise with increase in the acre-yield of the produce. This point has a very important bearing in evaluating the needs of common irrigation and the merits of the Sultanpur Pilot Irrigation Project in the Mehrauli area.

Some salient Features Regarding Employment Potential, Brick Making, Perennial Irrigation etc.

1. It has tremendous employment potential for both local and migratory rural labour population during the construction and post-construction period. In the former period about 100-200 people can be employed for 4-6 months while in the latter period the year-round intensive pattern of farming that develops with this project assures regular and not merely par-time employment. In a similar irrigation project of the Sultanpur big kucha well type now under construction at Asola village in Mehrauli N.E.S. Block with the financial resources of the Indian Co-operative Union, about 250-300 local rural labourers including the beneficiery farmers are working every day. In many parts of West Bengal tanks under minor irrigation Schemes financed by the State Government on 50:50 basis are done also by the contractors or by the migratory labour population. This may be true of many other areas of the country.

2. It gives assured irrigation throughout the year and does neither limit the range and yield of crops nor create any problem of water-logging. In the canal irrigated areas the annual closure of canals for desilting work and the non-availability of water for a certain period of the year preceding kharif season limits the range and yield of crops. While working in the DVC and Mor canal irrigated areas we found that the non-availability of water from the canals from April to June hampered our efforts to introduce large-scale greenmanuring, sugarcane, jute, and aus cultivation. A reprint of my paper relating to this point is enclosed (Appendix II). It may be noted that the most intensive vegetable cultivation has developed generally not in areas fed directly by gravity irrigation from the canals but by lift irrigation either from open wells, tanks, tubewells, and canals, etc. It has become almost an axiom in our country from our past experience that water-logging goes with canal irrigation and the State of Punjab alone has estimated an expenditure

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of Rs 80 crores to undo the evils of water-logging (now manifested through crop failures and declined yield) through the improvement of drainage.

3. The workable top soil obtainable from the excavation of the big kucha well may be profitably utilised for brick making. This will reduce the height of the embankment. The bricks thus made will compensate for the cost of construction on the one hand and on the other hand may be used for irrigation channels, rural housing and cattle shed, etc. Depending on the depth of workable soil the construction cost may be reduced substantially through brick making.

4. The raised embankment around the well may be profitably utilised for orchard and nursery with an annual income of about Rs 1000 - Rs 2000 per acre.

5. In areas of Delhi State where the tubewell cannot go deep because of the presence of salts in the deeper aquifer, the pilot project of the Sultanpur type excavated upto practicable salt-free depth, may allow tapping of the salt-infested deeper aquifers through boring to augment the flow and at the same time dilute the salt content to a concentration usable by crops.

Land Availability For Excavation, Silting Up, Erosion Hazard, pump shifting etc.

The necessity of land for the establishment of an irrigation scheme is common to all projects.. In commonly owned irrigation projects such as tanks executed by the farmers with the financial and technical help of the Government, the land is to be provided by the beneficiaries - no matter whether the land is common village land or privately owned. In the case of bund type tanks fed by runoff from the catchment the submergence area may be 5 acres or more in many cases and this area is donated by the beneficiaries. This has been my experience in West Bengal in the execution of minor irrigation works under 'Grow More Food' scheme. At Sultanpur the site covered by excavation and spill is about 1-5 acres and has been the common village land while that at Asola it has been donated by those beneficiaries who own the land.

In our country tanks which irrigate about 16% of the total irrigated area are subject to silting up and erosion hazard of their high embankment. Silting up occurs also in masonry wells. Silting up of the bed and erosion hazard of the high embankment are also common features of the canal systems of the country.

Nevertheless, these different irrigation projects have multiplied in the country. The answer is simple. Regular desilting work takes care of silt deposit and sod turfing of the embankment reduces erosion hazard to the minimum. Shifting of pumps with the receding water table is common to many parts of the country where masonry wells are operated by pumps.

The increasing demand of the diesel pumps in the country shows that it is a very popular water-lifting device with the farmers. In regions where electricity has been made available to the farmers for irrigation purpose, they have been quick to replace diesel by electricity and the cost of running and maintenance has been considerably reduced. It may be noted that the rural electrification is an important development item under the 5-year plans.

The same way silting up, erosion hazard, and pump shifting can be taken care of in the Sultanpur project:

i) The erosion hazard at Sultanpur is only for 3 months - from July to September. The reduction in the height of the embankment through brick making and the construction of a sodded channel at the junction of the foot of the inner side of the

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embankment and the first horizontal berm with a backward slope, can still further reduce erosion hazard. The collected silt-free run off flowing from sodded embankment can be safely discharged through inexpensive outlet pipes straight into the water of the well.

ii) As to the shifting of the pump, this offered no problem at all at Sultanpur. The vertical fall between successive platforms is about 10 ft. and when the pump fails to give effective discharge on any one platform, the water table will be below the next lower platform by about 5-6 ft. for a period sufficient to dry up the lower platform and allow safe movement of men and pumping equipment for installation. This had actually been done at Sultanpur when the pump was removed from the first to the second platform.

iii) The upward shifting of the pump in the face of submergence by a rising water table under conditions when there have been rains and the next irrigation is delayed, can be done in the same way. But such upward shifting in practice will not be necessary since in any season there will be crops with the different water requirements, and hence the delay caused by rains will not be of such length as to allow sufficient rise in the water table to submerge the pump. This had been the experience at Sultanpur during this rabi season when there had been rains and wheat did not need irrigation, but the vegetable fields were being prepared, irrigated and sown. The pump is still working on the second platform since its installation there 3 months ago. It may be stated that the placement of the pumps on the different platforms will be based on the working experience and cannot offer any practical difficulty at all as had been shown by the working of the Pilot Project at Sultanpur.

The Structural Stability

As already stated, the average life of a tubewell ranges from 15-18 years. What should be the life of an open kucha well of the Sultanpur type? In other words, does the well, especially the last 20 ft. vertical wall from the bottom possess adequate stability to give it a fruitful and economic life? Or does this 20 ft. portion of the wall need stone pitching or concrete work to protect it against sloughing?

The soil available in the profile right down to the bottom is clay of the 2:1 type with admixture of lime kankars and is relatively stable. It is understood that the eight feet of the last 20 ft. vertical wall under reference was stone pitched in half the circumference. A sum of Rs 853/- for stone-pitching is shown on page 6 of the redrafted report.

In situations where the stabilisation of the vertical portion of the wall may be a necessity, this cannot be a serious handicap to the execution of the fruitful irrigation project of the Sultanpur type. The sloughing if any can be taken care of by the farmers themselves within an expenditure which seems to be quite reasonable in the light of Sultanpur experience. But in the laterite soil tracts the soil is too stable to need any protection against sloughing. This can be seen from the railway and road culvert walls made entirely of laterite blocks in many parts of the country.

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The Scope Of Application To Other Areas of the Country

It is something to see to believe the transformations in the pattern and intensiveness of agriculture which Sultanpur has undertaken with the completion of the project. The economics of the Sultanpur project has been fully discussed in my report and is quite promising in the exploitation of ground water resources for increased agricultural production. The other salient features singular to the projects have also been brought out.

The scope of application of the Sultanpur project to the different areas of the country becomes wider if we look upon it not as a rival but as a complement to other irrigation projects including the tubewell. In the State schemes provisions are made for tubewells, small masonry wells, tanks, etc. and all these schemes may be working in the same area although their relative merits are different. The idea is to make available to the farmers all possible irrigation projects. The sole objective of all these projects is to increase agricultural production.

The Sultanpur project also may be included under irrigation works jointly undertaken by farmers and the usual subsidy granted to the farmers by the State Government may be given for this project also. In case loan is advanced by the Government to the beneficiaries for the execution of the project, it may be considered by the Government whether or not the repayment period may be extended over 15 years as has been stated in the case of tubewells by the Irrigation Adviser to the Ministry of Food & Agriculture in his note "Report on Possibilities Of Tubewell Irrigation In Delhi State" submitted to the Home Ministry on 14.1.59.

The Executing Agency

The kind of agency required for the execution of any irrigation project is to be very carefully decided, since on this decision will depend the response of the farmers. In his note on the installation of tubewells in Delhi State referred to above, the Irrigation Adviser recommended four steps:-

i) the formation of a co-operative with the beneficiaries to whom the loan may be advanced,

ii) the construction of all water channels by the beneficiaries,

iii) the construction of electric transmission lines to the tubewells, and finally

iv) the installation of the tubewell.

The idea was very good but it did not work in practice as indicated on page 32 of the redrafted report. With my humble experience in extension I have felt that joint or group action by cultivators in farming is the first step towards creating a congenial atmosphere for the formation of a healthy co-operative. As is done at present, that is, the grant to the farmers in groups of Government financial help as subsidy or loan for jointly owned minor irrigation works, it may be considered by the Government whether or not a similar step may be adopted for the project of Sultanpur type also.

My report will be incomplete without paying tributes to the cadre of Indian Civil Service to which Mr. M. A. T. Iyengar belongs. This cadre of service has to its credit many important contributions in the fields of Science and education. Mr. Iyengar has been able to achieve this simple but practical scheme through his intimate association with test relief work in the districts of West

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Bengal where he worked as the district executive. His inverted "cone" type of big kucha well is an important contribution to the field of irrigated and intensive agriculture.

8/3/61

(A. K. Dutt)
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NOTE OF DISSENT

By

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To

"Report Of The Technical Committee

ON

Large-Sized Kutcha Irrigation Wells"

New Delhi
March , 1961

CONTENTS

		Page
1.	Introduction	1
2.	The pre-irrigation agriculture of Sultanpur	1
3.	Recommendations of Geological Survey of India	1
4.	Flow from open wells	2
5.	The irrigation potential	2
6.	Comparative cost of small masonry wells on the basis of the equivalent irrigation potential of the big kucha well of the Sultanpur Project	4
7.	Relative cost of excavation in other parts of the country	5
8.	The agricultural potential	5
9.	Prevalent Irrigation rate at Sultanpur and nearby villages	7
10.	Some salient features regarding employment potential, brick making, perennial irrigation etc.	7
11.	Land availability for excavation, silting up, erosion hazard, pump shifting etc.	8
12.	The structural stability	9
13.	The scope of application to other areas of the country	10
14.	The executing agency	10

Introduction

As per terms of reference vide Ministry of Food and Agriculture No.2-1/59 IMN dt. the 12th August, 1960 for the scientific evaluation of the Sultanpur Pilot Irrigation Project, the committee required the relevant vital information on other alternative sources of irrigation in Mehrauli area. The average irrigated-areas of small masonry wells at Sultanpur and Chatarpur provided to the committee by the Engineering staff of the Delhi Administration on two occasions were proved to be wrong and ultimately the help of the Revenue Assistant of the Delhi Administration had to be sought for to obtain the correct figures. Thus the committee spent 3 days to obtain information only on one alternative source of irrigation that was masonry well. The various appendices given with the redrafted report had not been discussed at the committee meetings.

In my D.O.No.60/SFS-295, dt. November 28, 1960 and D.O.No.60/SFS-299, dt. November 30, 1960 to the Irrigation Adviser, I had requested him for some very vital information that would enable me to submit my comments on the first drafted report. The information was given at the last meeting and before closing of this meeting it was announced that the date of the next meeting would be communicated to the members.

In the mean time the redrafted report was received by me on December 28, 1960 from the Irrigation Adviser and immediately in my D.O.No.60/SFS-311, dt. December 28, 1960 to him information on the date of the next meeting was requested by me. But no further meeting was held.

In my last above-mentioned D.O. to the Irrigation Adviser I had stated that I had not agreed with many of the points expressed in the redrafted report. I have now prepared my note of dissent on the redrafted report. The more recent information that has become available from the working of the Sultanpur project has also been utilised in the preparation of my dissension note.

The Pre-irrigation Agriculture Of Sultanpur

I have been intimately associated with extension work at Sultanpur village since July, 1959 when the Pilot Irrigation Project of big, open kucha well was under construction. The annual rainfall of Mehrauli is about 18". The crops grown are predominantly rainfed, and only small areas are irrigated by a few masonry wells. The principal kharif crops are jowar and bajra while the rabi crops are barley, gram and mustard. Wheat, vegetables, maize, sugarcane, chari fodder, etc. cannot be grown without supplementing the rainfall with irrigation. In other words, the full benefits from the use of improved agricultural practices covering the aspects of soils, fertilisers and manures, improved seeds, improved implements, etc. can only be realised in these areas with the help of timely and adequate irrigation.

Irrigation, it may be recalled, played the key role in the selection of districts under the Ford Foundation Plan for intensive agricultural development (Package Programme). In fact intensive agriculture generally requires for its effective development an Irrigation Base.

Recommendations of Geological Survey of India

This area, according to the information available, cannot be commanded by canal or tank irrigation. The only possibility of supplying additional water for crops is the explitation of the ground water resources.

As far back as 1949, 2 test tube wells were drilled by the Central Ground Water Organisation in Chatarpur Basin near Mehrauli to a depth of 220 ' to 300'. The initial discharge was 12,000 gallons per hour with a depression of the water level by about 62', but the yield of water had gone down to 6,000 to 7,000 gallons per hour within a few months.

According to the findings and recommendations of Mr. D.N. Sett of Geological Survey of India, the geological conditions of Chatarpur basin of Mehrauli might not be suitable for extensive tubewell operations and instead wells of large-diameter ought to be sunk to a minimum depth of 100 ' or so in the area.

According to the findings and recommendations of Shri K.R. Madhwa Simha of Geological Survey of India, tubewells in some areas of the Chatarpur Basin may be expected to give good results, but in the neighbourhood of Ghatorni and Maidangari only large diameter wells will be useful. His recommendation on the depth of boring of tubewells varies from 250-400'.

In view of the uncertainties of obtaining good and sustained flows through tubewells in this area, the Exploratory Tubewell Organisation has advised that in every site proposed for a tubewell, a pilot bore should first be drilled and tested.

Flow from Open Wells.

The Technical Committee set up in 1958 had remarked that "the large kucha irrigation wells of the type envisaged by Shri Iyengar may not be expected to give a discharge more than 1500 to 2000 gallons even in favourable strata, etc." But known facts about flows from open wells conflict with this statement.

The Geological Survey Report of 1954 on the groundwater resources of West Bengal indicates a discharge of 800 gallons from a dug well of 4 ft. diameter and 4000 gallons from a well of 10 ft. diameter.

The redrafted report on page 22 had indicated for the well of Shri Ram Phal of Sultanpur to have an inflow more than 3,000 gallons per hour during pumping.

The 16 ft. diameter well of Chaudhuri Ramji Lal of Sultanpur, excavated to a depth of about 80 ft., was said to have a flow of 6000-8000 gallons per hour.

The 9-10 ft. diameter well of Shri Mam Chand of Sultanpur, excavated to a depth of about 55 ft., was said to have a flow less than 2000 gallons per hour. in spite of 3 borings having been made.

The measurements made in January, 1960 by the Assistant Engineer Delhi State on the flow of Sultanpur well then under construction are said to have given a flow of 6000 gallons per hour approximately exclusive of the inflow from boring.

These facts are themselves indicative of the deficiencies of the previous Technical Committee's remark about the maximum limit of flows in open wells.

The Irrigation Potential

Every Irrigation project has in it an irrigation potential and an agricultural potential. The economics of an irrigation project is generally determined by its cost, its irrigation potential, its agricultural potential, and its expected gross revenue.

The irrigation potential of the project under consideration with the sustained flow available at different seasons of the year can be fully judged under normal conditions, i.e. conditions which prevail in well-developed irrigated areas, such as level lands, economic use of water, seepage-proof conveyance channels, proper crop rotation etc. The sustained flow of the Project at maximum draw-down head has not been investigated at all by the committee. This seriously detracts from the value of observations and remarks about the yield of the well made in the redrafted report.

The observations of the committee were confined to a part of the monsoon and a part of the growing season of rabi crops. The discharge of the pump according to the officers deputed for the observation varied, going upto even 18,000 gallons per hour or so, as was verbally reported to me by them during my tour to the village. The Sultanpur farmers took up large scale irrigation for the first time last year from this project and the conditions were far from what prevailed in well-developed irrigated areas. According to the opinion expressed on page 20 of the redrafted report the annual irrigation potential of the project is 100 acres.

During the period of test in December, 1960 the pump worked on the average for 8 hours. Had all the farmers been ready for rabi irrigation last year, the pump would have worked for longer period (say, 12 hours a day) and at larger draw-down head. In that case the area that could be irrigated would have substantially increased. During discussion of the committee meeting it had been stated that the water yield of the open well could not be predicted as adequate data about the flow from such wells at different draw-down heads were not available. Hence the estimated yield of 6,000 gallons per hour at 30-35 draw-down head needs confirmation through test. Mr. Iyengar was said to have obtained a much higher flow at that draw-down or so before the beginning of 1960 monsoons.

Under a given set of conditions there will be two standard curves of yield from an open well, one from a depressing head and another from a replenishing head. One very pertinent question had been asked by me to the committee as to relative recuperation rates of a depressing as well as of a replenishing head of an open well for the same range of draw-down heads, say X_1 to X_2 and vice versa. The question could not be answered by the committee, though it had a very important bearing on determining scientifically and correctly the irrigation potential of the well.

In the case of either a replenishing or depressing head the inflow from the well is towards establishing the equilibrium of the physical system (the static water head). But the inflow in the case of a depressing head is towards replacement of the product of inflow (water) removed, a process which disturbs the equilibrium of the physical system. Thus according to the laws of dynamics governing the equilibrium of a physical system, the inflow during a falling head will be higher than that during a rising head.

The total yield of water delivered by a pump for a given working period determines the coverage by irrigation and is equal to the storage emptied plus the inflow from the well during the period of depression. Hence it is imperative that the recuperation rate of a falling head shall be used as a measure of the inflow from an open well for scientific assessment of yield. Therefore, the irrigation potential scientifically assessed will be higher than the irrigation potential shown on page 20 of the redrafted report.

Assuming that the recuperation at 30-35 ft. draw-down is 6,000 gallons per hour as shown on page 17 of the redrafted report and the pump works at that particular draw-down, the area of 50 acres for rabi shown on page 20 of the redrafted report will increase to 66 acres.

The wheat crops at Sultanpur required irrigation at an interval of 5-7 weeks this year. This interval is similar to that shown on page 19 of the redrafted report where 6-8 weeks interval is allowed in canal and tubewell irrigation of Uttar Pradesh. Hence the annual irrigation potential of 100 acres shown on page 20 of the redrafted report becomes very much of an underestimate as it is based on an irrigation interval of 30 days only.

Thus the area which can be irrigated by the project according to the interval of 5-7 weeks comes to 82-115 acres, say 80-110 acres.

When the discharge from the pump was 18,000 gallons per hour as had been reported to me by the officers deputed there, it was observed from the records that in the first irrigation some fields required about 7 hours to irrigate an acre. That is, one acre required about 5½ acre-inches. In fact almost all the fields required more than 4 acre-inches this year in the first irrigation. This was unavoidable when a new rain-fed area was brought under cultivation immediately with the completion of the project. The farmers will be able to effect substantial economy in the use of water in subsequent years. Thus with the economic use of water the area will increase substantially. The irrigation potential of the project should be judged not under abnormal conditions but under normal conditions that are generally obtainable in the well-established irrigated areas of the country.

Hence the seasonal irrigation potentials of the project are:-

Rabi (wheat) : 80-110 acres
Zaid rabi : 30-40 acres
Kharif : 80-100 acres
Total : 190-250 acres

The kharif crops will need only protective irrigation. Thus the annual irrigation potential of the project is 190-250 acres.

A tubewell with a discharge of 33,000 gallons per hour on the basis of 12 hours' working has been estimated to have an annual irrigation potential of about 420 acres as given on page 19 of the redrafted report. The Pilot tubewell irrigation project now contemplated for Chatarpur Basin with a discharge of about 10,000 000 gallons per hour on a similar basis of 12 hours' working will have an annual irrigation potential of 140 acres and not 200 acres as shown on page 23 of the redrafted report.

The average life of a tubewell ranges from 15-18 years. As to the life of the open wells Delhi itself can display more than 100-years old open wells which are still being effectively used for irrigation.

Comparative Cost Of Small Masonry Wells On The Basis Of The Equivalent Irrigation Potential Of The Big Kucha Well Of The Sultanpur Project.

The superiority of the big kucha well to a large number of small masonry wells with an equivalent aggregate annual irrigation potential has been fully discussed in the notes submitted to the committee by Dr. T.R.Mehta and myself (vide appendix VII and VIII of the redrafted report). In accordance with the information on the cost of small masonry wells given in appendix VII furnished with the letter No.2-1/59 IRN dt. the 12th August, 1960 of the Ministry of Food & Agriculture an ordinary masonry well at Sultanpur and Chattarpur villages costs on the average Rs 5,000/- and according to the latest information supplied to the committee by the Revenue Assistant of the Delhi Administration about the area irrigated by the 15 wells of Chatarpur during 1958 and 1959 kharif and during 1958-1960 rabi (vide memo No. 921-DIA/60, dt. the 4th November, 1960, issued by the Deputy Irrigation Adviser) the average area irrigated by such a well is not more than 4 acres in a year. Thus the Sultanpur Project is equivalent to:

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(a) 25 small masonry wells with a total cost of Rs 5,000/- x 25 or Rs 1,25,000/- as per estimate of the annual irrigation potential of the Sultanpur project shown on page 20 of the redrafted report.

(b) 47 to 62 small masonry wells with a total cost of Rs 2,35,000/- to Rs 3,10,000/- as per my estimate of the annual irrigation potential of the Sultanpur Project.

The cost of the Sultanpur pilot irrigation project including the pumps and irrigation channels is Rs 64,000/- as shown on page 6 of the redrafted report.

Relative Cost Of Excavation In Other Parts Of The Country

Compared to the cost of excavation of the Sultanpur well, what should be the cost of similar wells in other parts of the country? In places where the water table is nearer and the flow is more, the depth of excavation required for good flow will be less. Also where the wages are lower than Rs 2/- per day paid to the labourers of the Sultanpur Project, the cost of the well will certainly be proportionately less and not more as stated on page 7 of the redrafted report.

Had the excavation of the Sultanpur project been restricted to the period excluding the monsoon months and had the supply of materials and resources been made in time, the cost of excavation of the Sultanpur project would have been less.

The Agricultural Potential

As already stated, every irrigation scheme has an irrigation potential and an agricultural potential associated with it. The two together must be evaluated to assess the economic usefulness of any irrigation project. The period by which either of the potentials may be fully developed will depend, among other factors, on the effective extension service on the one hand and on the effective response and co-operation of the farmers, on the other.

In situations where both the factors are favourable, the full development of the agricultural potential may be attained in a relatively short period as indicated by the trend of extension work of Farm Advisory Unit at Sultanpur while the full development of the same potential primarily with farmers' initiative and resources is also possible but may take somewhat longer period as may be seen at the well-developed intensive vegetables and tobacco growing areas of Sahapur Jat, Chirag Delhi and Masjid Moth. But the agricultural potential is an inseparable feature of the project just as the irrigation potential is and hence it must be taken into account for a proper evaluation of the project.

Yardsticks which are employed at present in assessing increases in the outturn of the agricultural produce due to irrigation vary from 1/5th to 1/2 ton enhanced yield per acre. The question arises whether these yardsticks can be equally applied to all parts of the country, including regions of very low rainfall.

Let us take the case of Mehrauli with an annual rainfall of 18". Here some crops like maize grains, vegetables, sugarcane, wheat, tobacco, potatoes, etc., or summer (zaid rabi) vegetables or fodder crops (lobia) cannot be grown at all without irrigation on the upland soils. What increases in agricultural output due to irrigation should be considered? It is obvious that the entire output of such crops under such conditions is the additional production arising from irrigation.

The **next question that** arises is that with the full development of the agricultural potential what per cent of the total increase in agricultural production is due to irrigation and what per cent of the total is due to improved practices? The very low rainfall of Mehrauli immediately limits not only the range of crops but also the application of improved practices such as increasing use of fertilisers and manures, better crop rotations, etc. Hence irrigation is the primary factor under Mehrauli conditions, while all the other components of improved practices are entirely dependent upon it.

Let us now see what can be the gross acre-value of produce from the development of the agricultural potential with the irrigation of the Sultanpur project. In our demonstrations at Sultanpur with cauliflower, peas, and potatoes, etc. we have found that the gross acre-revenue may be Rs 2,140/- for the early cauliflower, Rs 1,500/- to Rs 2,000/- for early potatoes, and Rs 1,500/- or so for early peas. A reprint of our demonstration on cauliflower is enclosed (appendix I). However, let us take a conservative estimate of the gross revenue per acre for the evaluation of the project, say Rs 1,500/- for vegetables, Rs 600/- for wheat and mustard and maize and fodder crops etc. Thus, according to the annual irrigation potential of 100 acres as shown on page 20 of the redrafted report and my estimate of the irrigation potential of 190-250 acres (say 200 acres), the estimated annual gross revenues are:-

Annual Gross Revenue

			As per annual irrigation potential of the redrafted report	As per my estimate of the annual irrigation potential
1. Rabi	(a)	Wheat and mustard	30 acres Rs 18,000	60 acres Rs 36,000
	(b)	Vegetables	10 acres * Rs 15,000	20 acres * Rs 30,000
2. Zaidrabi	(c)	Vegetables	10 acres Rs 15,000	20 acres Rs 30,000
	(d)	Fodder crops	10 acres Rs 6,000	20 acres Rs 12,000
3. Kharif	(e)	Vegetables	20 acres Rs 30,000	40 acres Rs 60,000
	(f)	Fodder crops	10 acres Rs 6,000	20 acres Rs 12,000
		Total	Rs 90,000	Rs 1,80,000

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* When replacing wheat by vegetables, one acre of vegetable has been taken to be equivalent to 2 acres of wheat with regard to water requirement

Thus the annual gross revenues come to Rs 90,000/- and Rs 1,80,000/- for the annual irrigation potential of 100 and 200 acres respectively and far outweigh the total cost of Rs 64,000/- for the project. The annual net revenue will be about 70-80% of the gross values, that is Rs 63,000/- to Rs 72,000/- to Rs 1,26,000/- - Rs 1,44,000/-. It may be stated here that on account of the proximity of the village to the capital the farmers will gradually switch over to more intensive vegetable cultivation as can be seen at Sahapur Jat, Chirag Delhi, and Masjid Moth, and hence both the annual gross and net revenues will register further increase.

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The redrafted report has not touched at all upon the agricultural potential of the project without which the proper evaluation of the project is not possible, and frequent remarks which have been made in the said report about various operational phases of the project being uneconomic, cannot be considered valid.

Prevalent Irrigation Rate at Sultanpur and Nearby Villages:

There is a standing practice at Sultanpur and nearby villages with regard to the sharing of crops between farmers when one farmer receives water from the well of his neighbour. On enquiry from the farmers and the Patwari of Sultanpur, it transpired that the irrigation rate was generally paid in kind and that it amounted to 1/3 of the produce. This point was also confirmed by Mr. R.V.Rai, Sikka, Section Officer of B.D.O. Mehrauli, in the committee meeting held on November 25, 1960.

On my enquiry from the present B.D.O. of Mehrauli it was explained by him that inclusive of all charges such as man and bullocks working on Persian wheels as well as incidental costs, the irrigation rate would be equivalent to 1/3 of the crop produce. This point has not been clearly expressed on page 11 of the redrafted report, though it has a vital significance.

In other words, the irrigation rate in equivalent value of 1/3 of the crop produce will be Rs 150-200 for wheat, Rs 250-300 for sugarcane, potatoes etc., and this value will rise with increase in the acre-yield of the produce. This point has a very important bearing in evaluating the needs of common irrigation and the merits of the Sultanpur Pilot Irrigation Project in the Mehrauli area.

Some salient Features Regarding Employment Potential, Brick Making, Perennial Irrigation etc.

1. It has tremendous employment potential for both local and migratory rural labour population during the construction and post-construction period. In the former period about 100-200 people can be employed for 4-6 months while in the latter period the year-round intensive pattern of farming that develops with this project assures regular and not merely par-time employment. In a similar irrigation project of the Sultanpur big kucha well type now under construction at Asola village in Mehrauli N.E.S. Block with the financial resources of the Indian Co-operative Union, about 250-300 local rural labourers including the beneficiery farmers are working every day. In many parts of West Bengal tanks under minor irrigation Schemes financed by the State Government on 50:50 basis are done also by the contractors or by the migratory labour population. This may be true of many other areas of the country.

2. It gives assured irrigation throughout the year and does neither limit the range and yield of crops nor create any problem of water-logging. In the canal irrigated areas the annual closure of canals for desilting work and the non-availability of water for a certain period of the year preceding kharif season limits the range and yield of crops. While working in the DVC and Mor canal irrigated areas we found that the non-availability of water from the canals from April to June hampered our efforts to introduce large-scale greenmanuring, sugarcane, jute, and aus cultivation. A reprint of my paper relating to this point is enclosed (Appendix II). It may be noted that the most intensive vegetable cultivation has developed generally not in areas fed directly by gravity irrigation from the canals but by lift irrigation either from open wells, tanks, tubewells, and canals, etc. It has become almost an axiom in our country from our past experience that water-logging goes with canal irrigation and the State of Punjab alone has estimated an expenditure

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of Rs 80 crores to undo the evils of water-logging (now manifested through crop failures and declined yield) through the improvement of drainage.

3. The workable top soil obtainable from the excavation of the big kucha well may be profitably utilised for brick making. This will reduce the height of the embankment. The bricks thus made will compensate for the cost of construction on the one hand and on the other hand may be used for irrigation channels, rural housing and cattle shed, etc. Depending on the depth of workable soil the construction cost may be reduced substantially through brick making.

4. The raised embankment around the well may be profitably utilised for orchard and nursery with an annual income of about Rs 1000 - Rs 2000 per acre.

5. In areas of Delhi State where the tubewell cannot go deep because of the presence of salts in the deeper aquifer, the pilot project of the Sultanpur type excavated upto practicable salt-free depth, may allow tapping of the salt-infested deeper aquifers through boring to augment the flow and at the same time dilute the salt content to a concentration usable by crops.

Land Availability For Excavation, Silting Up, Erosion Hazard; pump shifting etc.

The necessity of land for the establishment of an irrigation scheme is common to all projects. In commonly owned irrigation projects such as tanks executed by the farmers with the financial and technical help of the Government, the land is to be provided by the beneficiaries - no matter whether the land is common village land or privately owned. In the case of bund type tanks fed by runoff from the catchment the submergence area may be 5 acres or more in many cases and this area is donated by the beneficiaries. This has been my experience in West Bengal in the execution of minor irrigation works under 'Grow More Food' scheme. At Sultanpur the site covered by excavation and spill is about 1-5 acres and has been the common village land while that at Asola it has been donated by these beneficiaries who own the land.

In our country tanks which irrigate about 10% of the total irrigated area are subject to silting up and erosion hazard of their high embankment. Silting up occurs also in masonry wells. Silting up of the bed and erosion hazard of the high embankment are also common features of the canal systems of the country.

Nevertheless, these different irrigation projects have multiplied in the country. The answer is simple. Regular desilting work takes care of silt deposit and sod turfind of the embankment reduces erosion hazard to the minimum. Shifting of pumps with the receding water table is common to many parts of the country where masonry wells are operated by pumps.

The increasing demand of the diesel pumps in the country shows that it is a very popular water-lifting device with the farmers. In regions where electricity has been made available to the farmers for irrigation purpose, they have been quick to replace diesel by electricity and the cost of running and maintenance has been considerably reduced. It may be noted that the rural electrification is an important development item under the 5-year plans.

The same way silting up, erosion hazard, and pump shifting can be taken care of in the Sultanpur project:

i) The erosion hazard at Sultanpur is only for 3 months - from July to September. The reduction in the height of the embankment through brick making and the construction of a sodded channel at the junction of the foot of the inner side of the

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embankment and the first horizontal berm with a backward slope, can still further reduce erosion hazard. The collected silt-free run-off flowing from sodded embankment can be safely discharged through inexpensive outlet pipes straight into the water of the well.

ii) As to the shifting of the pump, this offered no problem at all at Sultanpur. The vertical fall between successive platforms is about 10 ft. and when the pump fails to give effective discharge on any one platform, the water table will be below the next lower platform by about 5-6 ft. for a period sufficient to dry up the lower platform and allow safe movement of men and pumping equipment for installation. This had actually been done at Sultanpur when the pump was removed from the first to the second platform.

iii) The upward shifting of the pump in the face of submergence by a rising water table under conditions when there have been rains and the next irrigation is delayed, can be done in the same way. But such upward shifting in practice will not be necessary since in any season there will be crops with the different water requirements, and hence the delay caused by rains will not be of such length as to allow sufficient rise in the water table to submerge the pump. This had been the experience at Sultanpur during this rabi season when there had been rains and wheat did not need irrigation, but the vegetable fields were being prepared , irrigated and sown. The pump is still working on the second platform since its installation there 3 months ago. It may be stated that the placement of the pumps on the different platforms will be based on the working experience and cannot offer any practical difficulty at all as had been shown by the working of the Pilot Project at Sultanpur.

The Structural Stability

As already stated, the average life of a tubewell ranges from 15-18 years. What should be the life of an open kucha well of the Sultanpur type? In other words, does the well, especially the last 20 ft. vertical wall from the bottom possess adequate stability to give it a fruitful and economic life? Or does this 20 ft. portion of the wall need stone pitching or concrete work to protect it against sloughing?

The soil available in the profile right down to the bottom is clay of the 2:1 type with admixture of lime kankars and is relatively stable. It is understood that the eight feet of the last 20 ft. vertical wall under reference was stone pitched in half the circumference. A sum of Rs 853/- for stone-pitching is shown on page 6 of the redrafted report.

In situations where the stabilisation of the vertical portion of the wall may be a necessity, this cannot be a serious handicap to the execution of the fruitful irrigation project of the Sultanpur type. The sloughing if any can be taken care of by the farmers themselves within an expenditure which seems to be quite reasonable in the light of Sultanpur experience. But in the laterite soil tracts the soil is too stable to need any protection against sloughing. This can be seen from the railway and road culvert walls made entirely of laterite blocks in many parts of the country.

The Scope Of Application To Other Areas of the Country

It is something to see to believe the transformations in the pattern and intensiveness of agriculture which Sultanpur has undertaken with the completion of the project. The economics of the Sultanpur project has been fully discussed in my report and is quite promising in the exploitation of ground water resources for increased agricultural production. The other salient features singular to the projects have also been brought out.

The scope of application of the Sultanpur project to the different areas of the country becomes wider if we look upon it not as a rival but as a complement to other irrigation projects including the tubewell. In the State schemes provisions are made for tubewells, small masonry wells, tanks, etc. and all these schemes may be working in the same area although their relative merits are different. The idea is to make available to the farmers all possible irrigation projects. The sole objective of all these projects is to increase agricultural production.

The Sultanpur project also may be included under irrigation works jointly undertaken by farmers and the usual subsidy granted to the farmers by the State Government may be given for this project also. In case loan is advanced by the Government to the beneficiaries for the execution of the project, it may be considered by the Government whether or not the repayment period may be extended over 15 years as has been stated in the case of tubewells by the Irrigation Adviser to the Ministry of Food & Agriculture in his note "Report on Possibilities Of Tubewell Irrigation In Delhi State" submitted to the Home Ministry on 14.1.59.

The Executing Agency

The kind of agency required for the execution of any irrigation project is to be very carefully decided, since on this decis will depend the response of the farmers. In his note on the installati of tubewells in Delhi State referred to above, the Irrigation Adviser recommended four steps:-

i) the formation of a co-operative with the beneficiaries to whom the loan may be advanced,

ii) the construction of all water channels by the beneficiaries,

iii) the construction of electric transmission lines to the tubewells, and finally

iv) the installation of the tubewell.

The idea was very good but it did not work in practice as indicated on page 32 of the redrafted report. With my humble experience in extension I have felt that joint or group action by cultivators in farming is the first step towards creating a congenial atmosphere for the formation of a healthy co-operative. As is done at present, that is, the grant to the farmers in groups of Government financial help as subsidy or loan for jointly owned minor irrigation works, it may be considered by the government whether or not a similar step may be adopted for the project of Sultanpur type also.

My report will be incomplete without paying tributes to the cadre of Indian Civil Service to which Mr. M. A. T. Iyengar belongs. This cadre of service has to its credit many important contributions in the fields of Science and education. Mr. Iyengar has been able to concieve this simple but practical scheme through his intimate association with test relief work in the districts of West

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